

KAM-1/TSEC

REGISTER NO. 1

**CRYPTOCLEARANCE  
NOT REQUIRED**

~~CONFIDENTIAL~~

**REPAIR AND MAINTENANCE INSTRUCTIONS  
FOR  
TSEC/KL-7 (AFSAM 7)—JOINT**

**SECRET**

Upon receipt, consult List of Effective Pages  
and verify presence of each page

THIS PUBLICATION IS NOT TO BE  
DESTROYED. WHEN NO LONGER  
REQUIRED, IT SHOULD BE  
TURNED OVER TO THE HISTORICAL RECORDS  
SECTION OF THE NATIONAL SECURITY AGENCY

DEPARTMENT OF DEFENSE  
NATIONAL SECURITY AGENCY  
WASHINGTON 25, D. C.

**LIBRARY**

MAY 1955

~~CONFIDENTIAL~~

Declassified by NSA 03-30-2009  
pursuant to E.O. 12958, as  
amended, FOIA Case# 47709

**ORIGINAL**  
(Reverse Blank)

KAM-1/TSEC

REGISTER NO. 1

**CRYPTOCLEARANCE  
NOT REQUIRED**

~~CONFIDENTIAL~~

**REPAIR AND MAINTENANCE INSTRUCTIONS  
FOR  
TSEC/KL-7 (AFSAM 7)—JOINT**

Upon receipt, consult List of Effective Pages  
and verify presence of each page

DEPARTMENT OF DEFENSE  
NATIONAL SECURITY AGENCY  
WASHINGTON 25, D. C.

MAY 1955

~~CONFIDENTIAL~~

ORIGINA

KAM-1/TSEC

~~CONFIDENTIAL~~DEPARTMENT OF DEFENSE  
NATIONAL SECURITY AGENCY  
WASHINGTON 25, D. C.

1 May 1955

REPAIR AND MAINTENANCE INSTRUCTIONS FOR TSEC/KL-7—JOINT  
LETTER OF PROMULGATION

1. KAM-1/TSEC is a CONFIDENTIAL Registered Publication and will be handled, stored, and accounted for in accordance with the current regulations of the appropriate Department, Agency, or other controlling authority, pertaining to registered cryptomaterial. Cryptoclearance is not required for personnel having access to this publication.

2. KAM-1/TSEC will become effective upon receipt, and will supersede AFSAG 1233 and AFSAG 1233-1, at which time destruction of AFSAG 1233 and AFSAG 1233-1 is authorized. Instructions for the eventual disposal of this publication will be issued at an appropriate time by the Director, National Security Agency.


3. Changes to this publication will be promulgated by means of a printed change, letter, memorandum or message. Individuals entering such changes shall so indicate on the Record of Corrections page included herein as page 5.

4. This publication is distributed to authorized holders of TSEC/KL-7 (AFSAM 7) and associated publications.

5. THIS PUBLICATION CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U. S. C., SECTIONS 793, 794, AND 798. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

6. IT IS FORBIDDEN TO MAKE EXTRACTS FROM OR TO COPY THIS PUBLICATION WITHOUT SPECIFIC AUTHORITY FROM THE DIRECTOR, NATIONAL SECURITY AGENCY.

7. This publication may be carried in aircraft for use therein.

RALPH J. CANINE  
Lieutenant General, US Army  
Director~~CONFIDENTIAL~~

ORIGINAL

FLYLEAF RECEIPT

From: .....  
(Title) (Name of Command)

To: .....

Subject: KAM-1/TSEC Register No. 1

The subject publication has been received and checked against the List of Effective Pages contained therein by:

.....  
(Custodian's Sig., Rank, Serial No.)

- a. No discrepancies were found.
- b. Discrepancies were found as follows:

("X" out a. or b. as appropriate)

.....  
(Date)

.....  
(Signature of Commanding Officer)  
(Required of Navy Commands only)



FLYLEAF RECEIPT

From: .....  
(Title) (Name of Command)

To: .....

Subject: KAM-1/TSEC Register No. 1

The subject publication has been received and checked against the List of Effective Pages contained therein by:

.....  
(Custodian's Sig., Rank, Serial No.)

a. No discrepancies were found.

b. Discrepancies were found as follows:

("X" out a. or b. as appropriate)

.....  
(Date)

.....  
(Signature of Commanding Officer)  
(Required of Navy Commands only)

FLYLEAF RECEIPT

From: .....  
(Title) (Name of Command)

To: .....

Subject: KAM-1/TSEC Register No. 1

The subject publication has been received and checked against the List of Effective Pages contained therein by:

.....  
(Custodian's Sig., Rank, Serial No.)

a. No discrepancies were found.

b. Discrepancies were found as follows:

("X" out a. or b. as appropriate)

.....  
(Date)

.....  
(Signature of Commanding Officer)  
(Required of Navy Commands only)

~~CONFIDENTIAL~~

KAM-1/TSEC

LIST OF EFFECTIVE PAGES

Note: BLANK pages are not indicated in the Page Numbers column when they fall within a group listing of page numbers. However, all BLANK pages in the publication are accounted for by means of the notation "Reverse (Page....) Blank" printed in the lower right-hand corner of each page immediately preceding the BLANK page.

SUBJECT	Effective Pages	Page Numbers (Inclusive)
Title Page.....	ORIGINAL	1 ✓
Letter of Promulgation.....	ORIGINAL	2 ✓
List of Effective Pages.....	Change No. 3	3-4
Record of Corrections.....	ORIGINAL	5 Reverse (Page 6) Blank
Table of Contents.....	Change No. 1	7-11 Reverse (Page 12) Blank
List of Illustrations.....	Change No. 1	13-14 ✓
CHAPTER 1.....	Change No. 3	15 Reverse (Page 16) Blank
CHAPTER 2.....	ORIGINAL	17-20 ✓
	Change No. 1	21-22 ✓
CHAPTER 3.....	ORIGINAL	23-26 ✓
	Change No. 1	27-28 ✓
	ORIGINAL	29-31 Reverse (Page 32) Blank
CHAPTER 4.....	ORIGINAL	33-50 ✓
	Change No. 1	50.1-50.2 ✓
	ORIGINAL	51-64 ✓
	Change No. 1	65-67 Reverse (Page 68) Blank
CHAPTER 5.....	ORIGINAL	69-100 ✓
	Change No. 2	101-104 ✓
CHAPTER 6.....	ORIGINAL	105-114 ✓
	Change No. 1	115-116
	ORIGINAL	117-118
CHAPTER 7.....	ORIGINAL	119-120
	Change No. 2	121-122
	ORIGINAL	123-143 Reverse (Page 144) Blank
CHAPTER 8.....	ORIGINAL	145-159 <sup>9</sup> Reverse (Page 160) Blank
	Change No. 2	161-162
	Change No. 1	162.1-162.2
CHAPTER 9.....	Change No. 3	163-165 Reverse (Page 166) Blank
Figures 1-2.....	Change No. 3	167-170
Figure 3.....	ORIGINAL	171-172
Figure 4.....	Change No. 3	173-174

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## LIST OF EFFECTIVE PAGES—(Continued)

SUBJECT	Effective Pages	Page Numbers (Inclusive)
Figures 5-8.....	ORIGINAL	175-182
Figure 9.....	Change No. 1	183-184
Figure 10.....	ORIGINAL	185-186
Figure 11.....	Change No. 2	187-188
Figures 12-29.....	ORIGINAL	189-224
Figure 30.....	Change No. 3	225-226
Figures 31-33.....	ORIGINAL	227-232
Figure 34.....	Change No. 1	233-234
Figures 35-38.....	ORIGINAL	235-242
Figures 39-40.....	Change No. 2	243-244
Figures 41-42.....	Change No. 1	245-246
Figures 43-44.....	ORIGINAL	247-248
Figures 45-57B.....	Change No. 1	249-262.1 Reverse (Page 262.2) Blank
Figures 58-61.....	Change No. 2	263-269 Reverse (Page 270) Blank
Figures 62-65.....	ORIGINAL	271-277 Reverse (Page 278) Blank
Figure 66.....	Change No. 2	278.1 Reverse (Page 278.2) Blank
List of Replacement Parts.....	ORIGINAL	279-283 Reverse (Page 284) Blank
Numerical List of Parts.....	Change No. 1	285-300.2
Appendix A—List of Recommended Tools.....	Change No. 2	301-302
Appendix B—Interchangeability of Superseded Part Numbers.....	Change No. 1	303-304.23 Reverse (Page 304.24) Blank
Appendix C—Replaceable Parts for Devices Used With the TSEC/ KL-7.....	Change No. 2	305-306
Index.....	ORIGINAL	307-323 (Reverse Blank)

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

RECORD OF CORRECTIONS

Identification of Correction or Change and Reg No. (if any)	Date Entered	By Whom Entered (Signature; Rank or Rate; Name of Command)
MSG CORR. NR. 1 DTG: 202107Z	28 Dec. 1955	
CHG. NO. 1 w/errata	2 Aug. 1956	
MSG. CORR. NO. 2 (DTG 121703Z)	18 Feb. 1957	
CHG NO. 2 (REG # 1) DTG 091700Z	20 Aug. 1958	
MSG. CORR. No 3	18 Sept '59	
CHG. NO. 3 TO KAM-1 (REG # 1) DTG 251818Z 25 Sep '60	18 Feb. '60	
MSG. CORR. No 4	3 OCT 1960	
Pages check 11	04 OCT 1966	
	21 MAY 1982	

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## TABLE OF CONTENTS

## CHAPTER 1

## GENERAL

Section	Paragraph	Pages
1000 SCOPE		
Introduction.....	1001 .....	15
Comments or Recommendations.....	1002 .....	15

## CHAPTER 2

## INTRODUCTION AND DESCRIPTION

2000 INTRODUCTION		
General.....	2001 .....	17
Classification of Parts.....	2002 .....	17
Safeguarding of Equipment.....	2003 .....	17
2100 DESCRIPTION		
Size, Weight, and Power Requirements.....	2101 .....	18
Component Assemblies.....	2102 .....	18-19
General Function.....	2103 .....	19-21
Timing Cycle.....	2104 .....	21-22

## CHAPTER 3

## EMPLOYMENT

3000 PREPARATION FOR USE		
Unpacking Procedure.....	3001 .....	23
Inspection Procedure and Damage Report.....	3002 .....	23
Installation of Equipment.....	3003 .....	23-25
Test Procedures.....	3004 .....	25-27
Operational and Functional Errors.....	3005 .....	27
Installation of the KLX-7/TSEC Keyboard Adapter on the TSEC/KL-7.....	3006 .....	27
3100 TROUBLE SHOOTING		
Simplified Trouble-shooting Chart.....	3101 .....	28-31

## CHAPTER 4

## THEORY

4000 PHYSICAL DESCRIPTION AND MECHANICAL THEORY		
General.....	4001 .....	33
Base.....	4002 .....	33
Keyboard Assembly.....	4003 .....	33-34
Sliding Contact Board and Guide Rail Assembly.....	4004 .....	34-36
Contact Panel Assembly.....	4005 .....	35
Printer Assembly.....	4006 .....	36-46
Rotor Stepping Unit.....	4007 .....	46-50
KLX-7/TSEC Keyboard Adapter.....	4008 .....	50.1
Motor, Generator and Controller Assembly.....	4009 .....	50.1-50.2
CE 8806 AC Power Converter.....	4010 .....	50.2
CE 87422 Radio Interference Filter.....	4011 .....	50.2

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Section	Paragraph	Pages
4100 ELECTRONIC THEORY		
General	4101	51
Sliding Contact Board and Guide Rail Assembly	4102	51-52
Key Circuit, P Operation	4103	52-53
Key Circuit, E Operation	4104	53
Key Circuit, D Operation	4105	53-54
Special Key Circuits	4106	54-56
Electronic Circuits	4107	56
Sharpener Tube, V102	4108	56-57
Gate Tube, V104	4109	57-59
Print Tube, V101	4110	59-61
Shift Tube, V103	4111	61-63
Power Circuit	4112	63
CE 87066 Power Converter	4113	63-64
Common Return	4114	64
Low-voltage Supply	4115	64
High-voltage Supply	4116	64-65
Rotor Stepping Magnet Circuits	4117	65-67

## CHAPTER 5 CIRCUITS

5000 GENERAL		
Classification of Circuits	5001	69
Circuit Tracing Aids	5002	69
5100 KEY CIRCUITS		
General	5101	70
Normal Key Circuits	5102	70-71
Special Key Circuits	5103	71-78
5200 TUBE CIRCUITS		
Tube Functions	5201	79
Print Tube, V101	5202	79-84
Sharpener Tube, V102	5203	84-85
Shift Tube, V103	5204	85-86
Gate Tube, V104	5205	86-89
5300 POWER CIRCUITS		
General	5301	90
Input Circuit	5302	90
Motor-Generator and Controller Circuit	5303	91
Full-wave Rectifier	5304	91-92
Unisolated 200-volt Supply	5305	92-93
Isolated 220-volt Supply	5306	93
Negative 72-volt Bias Supply	5307	93
Common Circuit	5308	94
Tube Filament Circuit	5309	94
AC Power Converter	5310	94-96
5400 ROTOR STEPPING CIRCUIT		
General	5401	97
Fixed Connections	5402	97-99
Reentry Circuits	5403	99
Actuator Switches	5404	99-101
5500 CIRCUIT DATA		
Tables	5501	102-104

~~CONFIDENTIAL~~

CHAPTER 6  
MECHANICAL ADJUSTMENTS

Section	Paragraph	Pages
6000 GENERAL		
Procedure.....	6001 .....	105
6100 CIPHER UNIT		
General.....	6101 .....	106
Plunger Contact Spring Tension.....	6102 .....	106
Rotor Plunger Spring Tension.....	6103 .....	106
6200 ROTOR STEPPING UNIT		
Drive Pawl Spring Tension.....	6201 .....	107
Stop Assembly Spring Tension.....	6202 .....	107
Positioning Arm Spring Tension.....	6203 .....	107
Hold-down Spring Tension.....	6204 .....	107
Stepping Magnet Armature Spring Tension.....	6205 .....	107
Stepping Magnet Position Adjustment.....	6206 .....	107
Drive Pawl Effective Length Adjustment.....	6207 .....	107
Actuator Switch Clearance Adjustment.....	6208 .....	108-109
6300 PRINTER UNIT		
Drive Link Spring Tension.....	6301 .....	110
Crankshaft Miter Gear Backlash Adjustment.....	6302 .....	110
Timing Unit Adjustments.....	6303 .....	110
Timing Unit Pressure Contact Compression.....	6304 .....	110
Timing Unit Cam Switch Adjustments.....	6305 .....	110-111
Timing Unit Detent Pawl Spring Tension.....	6306 .....	111
Clutch Pawl Spring Tension.....	6307 .....	111
Trip Magnet Armature Spring Tension.....	6308 .....	111
Trip Magnet Position Adjustment.....	6309 .....	111
Trip Magnet Armature Gap Adjustment.....	6310 .....	111
Timing Unit Detent Pawl Adjustment.....	6311 .....	112
Pulse Generator Pressure Contact Compression.....	6312 .....	112
Tape Feed Mechanism Adjustments.....	6313 .....	112
No-back Pawl Spring Tension.....	6314 .....	112
Single-drive Ratchet Pawl Spring Tension.....	6315 .....	112
Detent Ratchet Pawl Spring Tension.....	6316 .....	112
Double-drive Ratchet Spring Compression.....	6317 .....	112
Stop Pawl Spring Tension.....	6318 .....	112
Double-drive Ratchet Pawl Spring Tension.....	6319 .....	113
No-back Pawl Adjustment.....	6320 .....	113
Double-drive Ratchet Pawl Adjustment.....	6321 .....	113
Feed Roll Follower Spring Tension.....	6322 .....	113
Ribbon Reversing Mechanism Adjustments.....	6323 .....	114
Shifting Lever Spring Tension.....	6324 .....	114
Ribbon Spool Compression Spring Tensions.....	6325 .....	114
Print Magnet Adjustments.....	6326 .....	114
Print Magnet Pressure Contact Spring Compression.....	6327 .....	114
Print Magnet Reed Spring Tension.....	6328 .....	114
Print Magnet Eccentric Adjustment.....	6329 .....	114
Motor-Generator and Controller Adjustments.....	6330 .....	114
Motor Brush Spring Tension.....	6331 .....	115
Motor-Generator and Controller Pressure Contact Compression.....	6332 .....	115
Motor-Generator and Controller Pressure Contact Alignment.....	6333 .....	115
Motor-Generator Speed Adjustment.....	6334 .....	115
Generator Output Voltage.....	6335 .....	115
Figured Wheel Adjustment.....	6336 .....	115-116
Motor-Generator Speed Adjustment (Governor Type).....	6337 .....	116
6400 KEYBOARD ASSEMBLY		
Key Switch Spring Compression.....	6401 .....	117
RPT Key Switch Spring Compression.....	6402 .....	117



~~CONFIDENTIAL~~

KAM-1/TSEC

Section	Paragraph	Pages
Space Bar Spring Tension.....	6403 .....	117
Power Switch Leaf Tension.....	6404 .....	117
Space Bar Pressure Contact Compression.....	6405 .....	117
Selector Handle Detent Action.....	6406 .....	117
<b>6500 PANEL AND BASE ASSEMBLY</b>		
Contact Panel Pressure Contact Compression.....	6501 .....	118
Contact Panel Follower Spring Tension.....	6502 .....	118
Stop Pin Spring Tension.....	6503 .....	118
Operator's Light Socket Pressure Contact Compression.....	6504 .....	118

## CHAPTER 7

## CLEANING AND LUBRICATION

<b>7000 GENERAL INFORMATION</b>		
Introduction.....	7001 .....	119
<b>7100 PROCEDURES FOR OPERATING PERSONNEL</b>		
General Instructions.....	7101 .....	120
Flat Head and Pressure Contacts.....	7102 .....	121
Procedures.....	7103 .....	121-122
Reassembly Instructions.....	7104 .....	122-123
<b>7200 GENERAL INFORMATION FOR TRAINED MAINTENANCE PERSONNEL</b>		
General.....	7201 .....	124-125
<b>7300 CLEANING PROCEDURES FOR TRAINED MAINTENANCE PERSONNEL</b>		
General.....	7301 .....	126
Preparation for Cleaning.....	7302 .....	126
Cipher Unit.....	7303 .....	126-127
Rotor Stepping Unit.....	7304 .....	127-129
Printer Unit.....	7305 .....	129-130
Front End Bell Cover Assembly and Attached Parts.....	7306 .....	130
Pulse Generator Assembly.....	7307 .....	130-132
Motor-Generator and Controller Assembly.....	7308 .....	132
Timing Unit.....	7309 .....	132-134
Crankshaft Assembly.....	7310 .....	134
Keyboard Assembly.....	7311 .....	134
Sliding Contact Board and Guide Rail Assembly.....	7312 .....	134
Contact Panel Assembly.....	7313 .....	134-135
Base Assembly.....	7314 .....	135
<b>7400 LUBRICATING PROCEDURES FOR TRAINED MAINTENANCE PERSONNEL</b>		
General.....	7401 .....	136
Lubricants.....	7402 .....	136
Base Assembly.....	7403 .....	136
Contact Panel Assembly.....	7404 .....	136
Sliding Contact Board and Guide Rail Assembly.....	7405 .....	136
Keyboard Assembly.....	7406 .....	136-137
Printer Assembly.....	7407 .....	137-142
Rotor Stepping Unit.....	7408 .....	142-143
Cipher Unit.....	7409 .....	143
General Maintenance Checks.....	7410 .....	143

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

CHAPTER 8  
SERVICE GUIDE

Section	Paragraph	Pages
8000	CHECKING PROCEDURES FOR MAINTENANCE PERSONNEL	
	General.....	8001 ..... 145
	Trouble-shooting Data.....	8002 ..... 145
	Packing Procedures.....	8003 ..... 145-146
	Transporting TSEC/KL-7 on Packboard.....	8004 ..... 146
	Vehicle Mounting Kit.....	8005 ..... 146-147
8100	TROUBLE-SHOOTING CHARTS	
	Trouble-shooting Charts.....	8101 ..... 148-161
8200	SUPPLEMENTARY INSTRUCTIONS FOR TRAINED MAINTENANCE PERSONNEL	
	CE 8788 Stator and End Bell Assembly.....	8201 ..... 162
	Detailed Procedures for Disassembly of Motor-Generator and Controller Assembly.....	8202 ..... 162-162.2

CHAPTER 9  
REPLACEMENT PARTS

9000	GENERAL	
	Identifying Parts.....	9001 ..... 163
	Ordering Parts.....	9002 ..... 163-164
	Disposal of Worn and/or Defective Parts.....	9003 ..... 164
	Emergency Repair.....	9004 ..... 164
	List of Abbreviations.....	9005 ..... 164-165
	STAMPING REGISTERED NUMBER ON KLK-7/TSEC NAMEPLATE.....	9006 ..... 165
9100	LISTS OF REPLACEMENT PARTS	
	List of Common Parts by Types.....	9101 ..... 279-283
	Numerical List of Parts.....	9102 ..... 285-300.2
	APPENDIX A	
	List of Recommended Tools.....	301-302
	APPENDIX B	
	Interchangeability of Superseded Part Numbers.....	303-304.23
	APPENDIX C	
	CE 87875 Vehicle Mounting Assembly <i>Replaceable Parts for Designs Used with TSEC KL-7</i> .....	305-306
	INDEX.....	307-323

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

LIST OF ILLUSTRATIONS

Figures	Description	Pages
<i>Descriptive Photographs</i>		
1	Cipher Machine in Operating Position.....	167-168
2	Base and Contact Panel Assemblies.....	169-170
3	Printer Assembly.....	171-172
4	Rotor Stepping and Cipher Unit Assemblies.....	173-174
5	Cipher Unit and Rotors, Exploded View.....	175-176
6	Vehicle Mount for TSEC/KL-7.....	177-178
7	Packboard Mount for TSEC/KL-7.....	179-180
<i>Descriptive Drawings</i>		
8	Block Diagram of Cipher Machine.....	181-182
9	Time and Rotation Chart.....	183-184
10	Ribbon Installation.....	185-186
11	Keyboard Assembly.....	187-188
12	Sliding Contact Board Assembly.....	189-190
13	Contact Panel Assembly.....	191-192
14	Miscellaneous Keyboard Switches.....	193-194
15	Shift Tube Circuits.....	195-196
16	Normal Key Circuit Switches.....	197-198
17	Space Circuit Switches.....	199-200
18	Figures Circuit Switches.....	201-202
19	Letters Circuit Switches.....	203-204
20	Motor-Generator and Controller Assembly.....	205-206
21	Pulse Generator Assembly and Associated Parts.....	207-208
22	Pulse Coil and Rotor Relationship.....	209-210
23	Timing Unit Assembly, Side and End Views.....	211-212
24	Timing Unit Assembly, Isometric View.....	213-214
25	Front End Bell and Paper Tape Feed Assembly and Associated Parts.....	215-216
26	Schematic Views of Paper Tape Feed Ratchets and Pawls.....	217-218
27	Ribbon Reversing Mechanism and Associated Parts.....	219-220
28	Ribbon Feed Schematic Views.....	221-222
29	Printer Gear Train.....	223-224
30	Rotor Stepping Unit Assembly.....	225-226
<i>Adjustment Drawings</i>		
31-35	Printer Assembly Adjustment.....	227-236
36	Keyboard, Contact Panel, and Base Assembly Adjustments.....	237-238
37, 38	Rotor Stepping Unit and Cipher Unit Assembly Adjustments.....	239-242
<i>Parts Drawings</i>		
39	CE 11941 Contact Panel Assembly.....	243
40	CE 11371 Keyboard Assembly.....	244
41	CE 87058 Timing Unit Assembly.....	245
42	CE 87420 Motor-Generator and Controller Assembly.....	246
43, 44	Tape Feed Parts.....	247-248
45	CE 87056 Pulse Generator Assembly.....	249
46, 47	CE 87059 Printer Assembly.....	250-251
48	CE 87011 Switch Assembly.....	252
49	CE 87068 Stepping Unit Assembly.....	253
50	CE 87067 Cipher Unit Assembly.....	254
51, 52	CE 87077 TSEC/KL-7 Cipher Machine.....	255-256
53	Carrying Case Assembly.....	257
54	CE 87075 Accessories and Case Assembly.....	258

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Figures	Description	Pages
55	Accessories Assembly.....	259
56	CE <del>88066</del> AC Power Converter Assembly.....	260
57	CE 87290 Operator Kit Assembly.....	261
57-A	CE 87422 Radio Interference Filter.....	262
57-B	CE 88000 Motor-Generator and Controller Assembly.....	262.1
<i>Wiring Diagrams</i>		
58	TSEC/KL-7 Contact Panel.....	263
59	TSEC/KL-7 Tube Socket Terminals.....	265
60	TSEC/KL-7 Schematic Diagram.....	267
61	TSEC/KL-7 Wiring Diagram.....	269
62	KLA-7/TSEC and KLK-7/TSEC Schematic Diagram.....	271
63	KLA-7/TSEC and KLK-7/TSEC Wiring Diagram.....	273
64	CE <del>88066</del> Power Converter Schematic Diagram.....	275
65	CE <del>88066</del> Power Converter Wiring Diagram.....	277
66	KLX-7/TSEC Keyboard Adapter Wiring Diagram.....	278.1

\* 88066 should be 87066 -  
per EIR to HQ #1

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## CHAPTER 1

## GENERAL

## 1000—SCOPE

**1001. Introduction.**

- a. This publication, "Repair and Maintenance Instructions for TSEC/KL-7 (AFSAM 7)—Joint" (short title KAM-1/TSEC) is ~~CONFIDENTIAL~~ and will be handled accordingly. It contains detailed instructions for the repair and maintenance of the TSEC/KL-7.
- b. Current operating instructions for TSEC/KL-7 are published for the guidance of operating personnel but may be referred to by maintenance personnel.
- c. No persons will attempt to perform repair and maintenance work on the TSEC/KL-7 unless they have successfully completed an approved course of instruction in the maintenance of the TSEC/KL-7 and are familiar with this publication. An "approved course of instruction" shall be construed to mean any training which is recognized by appropriate military Service or Federal Agency authority as meeting the requirements to fully qualify trainees in the repair and maintenance of the TSEC/KL-7.

**1002. Comments or Recommendations.**—Comments and/or recommendations concerning the contents of KAM-1/TSEC are invited. They should be forwarded, through normal Service channels, to the Assistant Director, National Security Agency, 3801 Nebraska Ave., N. W., Washington 25, D. C., ATTN: ENG.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

**CHAPTER 2**  
**INTRODUCTION AND DESCRIPTION**

**2000—INTRODUCTION**

**2001. General.**—TSEC/KL-7 is a compact, portable, light weight cipher machine designed for off-line use. It is a keyboard-operated, electro-mechanical cipher machine that can encipher or decipher messages at any speed up to 60 words per minute. The enciphered and deciphered text it produces is printed on a gummed paper tape.

**2002. Classification of Parts.**—The major component assemblies of TSEC/KL-7 and its accessories, together with their respective designations and classifications, are listed below.

- a. The base, designated KLB-7/TSEC, includes the sliding contact board and guide-rail assembly, contact panel, printer unit, and brackets. It is not registered and is not classified. The serial number stamped on its nameplate is for accounting purposes only.
- b. The 36-point rotor stepping unit, designated KLA-7/TSEC is a registered cryptographic item, classified CONFIDENTIAL.
- c. The 36-point cipher unit, designated KLK-7/TSEC, is a registered cryptographic item, classified CONFIDENTIAL.
- d. The carrying case is not registered and is not classified. The serial number stamped on its name plate is for accounting purposes only.
- e. The power converter, CE 87066, is not registered and is not classified. The serial number stamped on its name plate is for accounting purposes only.
- f. The accessory case, CE 87075, is not registered and is not classified. The serial number stamped on its name plate is for accounting purposes only.
- g. The office case, CE 14598, including power converter without cover, is not registered and is not classified. The serial number stamped on its name plate is for accounting purposes only.
- h. ~~The rotors are classified CONFIDENTIAL. Pollux rotors are classified CONFIDENTIAL.~~  
ADONIS rotors are classified SECRET. (MSC corr. nr. 2)
- i. When equipped with rotors, TSEC/KL-7 is classified CONFIDENTIAL.

**2003. Safeguarding of Equipment.**—TSEC/KL-7, together with its associated equipment, will be handled and accounted for in accordance with regulations of each Service governing the handling of cryptomaterial. Specific requirements for proper safeguarding of registered cryptomaterial are contained in KAG-1/TSEC (formerly AFSAG 1210), "Cryptographic Operations—Joint."

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## 2100--DESCRIPTION

**2101. Size, Weight, and Power Requirements.**

- a. The TSEC/KL-7 cipher machine is 12 inches wide, 12 inches long, and 6 $\frac{3}{8}$  inches high. The carrying case is 15 inches long, 9 $\frac{1}{2}$  inches wide, and 14 inches deep.
- b. TSEC/KL-7, including the KLA-7/TSEC stepping unit and the KLK-7/TSEC cipher unit weighs 20.5 pounds. The field carrying case weighs 12.5 pounds. Packed in its carrying case, the weight is 33 pounds.
- c. Normal power requirements of TSEC/KL-7 are 2.5 amperes at 24 volts DC, but the unit will operate over an input voltage range of from 21 to 31 volts. Where the available power is 110 volts or 220 volts AC, the required DC input is furnished by the ~~OE-87066~~ power converter.

**2102. Component Assemblies.**—TSEC/KL-7 is composed of the following assemblies: a base, keyboard, sliding contact board and guide rails, contact panel, printer unit, cipher unit, and rotor stepping unit. The associated accessory equipment includes an AC power converter (~~OE-87066~~), a carrying case, office case, and an accessories and case assembly. A brief explanation, which describes the general function of each assembly, follows.

- a. *Base Assembly.*—The base assembly (fig. 1) is the supporting frame on which the other components of the cipher machine are mounted. Tracks, which are machined along the four sides, and two brackets, engage shock mounts which are fastened within the carrying case and cover, thereby providing the required support during transportation. Supports and threaded inserts, positioned throughout the base, provide the means of locating, fastening, and supporting the various components. Threaded inserts at the corners provide for mounting the base within the office case. Two spring-loaded pins, which project through the bottom of the base, and a slotted spring stop allow the cipher machine to be pulled forward from the case to an operating position and a rotor-access position, while preventing the machine being pulled completely out of the case unintentionally. When the front pin hits the end of the slot in the spring stop, the machine is in its operating position. Depression of the spring stop while pulling forward on the machine until the second pin hits the end of the slot positions the machine for easy access to the cipher unit without removing the machine completely from the case.
- b. *Keyboard and Sliding Contact Board Assemblies.*—The keyboard assembly (fig. 1), together with the sliding contact board which is located beneath it, serves as a typing keyboard and multi-circuit switching device which establishes the various circuits of the cipher machine. The keyboard assembly contains 29 key switches, a space bar, the function selector handle for the sliding contact board, fuse holders, and a power cable and cover plate assembly. It is mounted directly on the contact panel assembly and is therefore electrically insulated from the metal base assembly. It is removable as a unit. The electric power input to the cipher machine is through the keyboard and sliding contact board assemblies.
- c. *Contact Panel Assembly.*—The contact panel assembly (fig. 2) carries the contacts through which the connections between the motor-generator, rotor stepping unit, and sliding contact board are established. It also carries the tube sockets, and the studs to which the resistors, capacitors, and germanium diodes are fastened. The contact panel is made of an electrical insulating material and is fastened directly to the metal base.
- d. *Printer Assembly.*—The printer assembly (fig. 3), which is mounted on the left side of the base assembly (fig. 1), consists of a motor-generator, pulse generator, print magnet assembly, tape and ribbon feed assemblies, and drive link assembly. It provides the mechanical power for the rotor stepping unit, the high voltage required by the electronic circuits, and precisely-timed electrical pulses which initiate the printing of characters on the gummed tape. It also automatically provides the spacing required between words, and opens and closes predeter-

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

mined circuits at the proper times. It is fastened to the base assembly by four captive screws and is removable as a unit.

- e. *Rotor Stepping Unit Assembly.*—The rotor stepping unit assembly (fig. 4) automatically steps the rotors of the cipher unit in a definite but unrecognizable pattern during the enciphering and deciphering functions. Rotor set keys provide a means of stepping the rotors individually when the selector handle is set to the P (plain text) position. The rotor stepping unit is secured to the base assembly in the position shown in figure 1 and may be removed from the base as a unit, with or without the cipher unit attached. A mechanical counter, which is attached to the front of the rotor stepping unit, counts each cycle made by the cipher machine.
- f. *Cipher Unit Assembly.*—The cipher unit assembly (fig. 4) houses the rotors (seven movable and one stationary) which are stepped in a definite pattern for the enciphering and deciphering functions. The cipher unit is fastened to the rotor stepping unit by means of latches which fit over the ends of the rotor shaft and lock it in position.
- g. *AC Power Converter.*—The AC power converter (fig. 56) is designed to convert either 110-volt or 220-volt AC power into the 21 to 31 volts of DC power required for operation of TSEC/KL-7. A slide-type switch located on top of the converter is employed to set the converter for operation on 100- 125-volt or 200- 250-volt, 50- 60-cycle AC power. Two fuse holders are supplied, one being connected in one side of the AC input line to afford protection against accidental connection to a 220-volt source when set up for 110-volt operation, while the other holds a spare fuse.
- h. *Carrying Case Assembly.*—The carrying case assembly (fig. 1) provides a shock- and moisture-resistant container for transporting the cipher machine, either by hand or on a standard pack-board. It is designed so that the cipher machine may be operated without withdrawing it completely from the case. In addition, the case provides a copy holder and storage space for the operating light, cable, additional paper tape, and spare typewriter ribbons.
- i. *Accessories and Case Assembly.*—The accessories and case assembly (fig. 55) resembles the carrying case in outward appearance. However, it is equipped with interior fittings for storage of accessory and spare equipment for TSEC/KL-7. The equipment contained in the accessories case will vary in accordance with the needs of a particular installation.
- j. *Office Case Assembly.*—At time of publication of this document, details of design and construction of the office case were not available. Therefore, references to the office case will be of a general nature only.

**2103. General Function (fig. 8).**—TSEC/KL-7 is an electro-mechanical cipher machine which produces plain text, an enciphered version of plain text, or a plain text (deciphered) version of an enciphered message on paper tape by means of a print-on-the-fly mechanism. Each time a key is depressed, a letter character is printed, the tape and inked ribbon are advanced one space and, when enciphering and deciphering, the rotors are stepped once in their normal pattern. Word spacing is accomplished with the space bar. Action is initiated electromagnetically as follows:

- a. Each key may be employed in plain text, enciphering, and deciphering functions. The circuitry for the function desired is set up by the sliding contact board as it is moved by turning the function selector handle to the P (plain), E (encipher), and D (decipher) positions. The sliding contact board is in reality a four-position, multiple contact switching device through which all key circuits and machine functions are routed. The fourth position (O) is an OFF position which disconnects both sides of the power input circuit from the power source.
- b. In P position, key closure completes a circuit directly to the pulse generator. The function of the pulse generator is to produce a pulse which will cause the print control tube to conduct and actuate the print hammer at the proper time so that the desired character is reproduced on the tape. The cipher unit is not used for the plain text function.
- c. In positions E and D, the cipher unit is connected into the circuit between the key contacts and the pulse generator so that key closure completes a circuit to the cipher unit, rather than

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

directly to the pulse generator. It is the function of the rotors to so transpose the circuit that an enciphered or deciphered version of the selected key is presented to the pulse generator. The printing action which follows is the same as for the plain text function, except, of course, the enciphered or deciphered version of the selected key is printed on the tape.

- d. More than one pulse which can initiate printing action may be fed to the print control tube during a single key closure. To avoid errors and repeat printing, only one pulse must be allowed to initiate the printing action. It is the function of the electronic circuits of TSEC/KL-7 to select the correct pulse. How this is done is described in subparagraphs *e* through *p*, which follow.
- e. The print control tube, which is a type 2D21 shield-grid thyatron, serves as an electronic switch for the print and trip magnets. When this tube fires, both magnets are energized and the printing and cycling actions are initiated. In this particular application, both grids of the thyatron are biased negatively. As a result, the tube will not begin to conduct until BOTH bias voltages are overcome simultaneously. It is this requirement which prevents random pulses from initiating printing action.
- f. Since the output of the pulse generator is insufficient to overcome the high negative bias applied to the control grid of the print tube, it must be amplified. It is also desirable that this pulse have a particular shape. These functions are performed by another type 2D21 thyatron, which is designated as the sharpener tube. The output of the pulse generator is stepped up by a transformer and applied directly to the control grid of the sharpener tube. The bias value for this tube is determined by the shift tube, as described in subparagraph *k* below. The sharpener tube is cathode coupled to the control grid of the print tube and transmits a selected pulse to the print tube every 27 milliseconds.
- g. The function of the gate tube, which is a type 12AX7 dual triode, is to overcome the bias on the shield grid of the print tube at the proper time. The gate tube is a single-shot multivibrator which is triggered at key closure. After a delay of 15 milliseconds, the leading edge of the positive gating voltage is applied to the shield grid of the print tube. This positive voltage is sufficient to overcome the bias on the shield grid and the print tube will fire when the control-grid bias is removed.
- h. While the gate tube is triggered only once, the sharpener tube fires several times during a single key operation. The print tube, however, cannot conduct until the gate voltage overcomes the bias on its shield grid. The next pulse to be transmitted from the sharpener then fires the print tube. When the print tube plate voltage falls below the extinction voltage of the tube, conduction ceases. Before the sharpener tube transmits another pulse, however, the gate voltage is removed from the print tube and the shield grid is once again highly negative. Thus, even though a key is held depressed for several moments, only a single character is printed.

*Note:* As long as the RPT (repeat) key is held depressed, bias is removed from the shield grid of the print tube. This action permits the print tube to fire every time a pulse is received from the sharpener tube. Hence, when the RPT key is depressed with some other key, continuous printing of the depressed key character occurs.

- i. Certain keys on the keyboard represent both a figure and a letter. These are alpha-numeric keys. The pulse generator contains *two* coils for each of these dual-function keys so that depression of any one of them causes two pulses to be supplied by the pulse generator. The pulse which represents the figure has a much greater amplitude than the pulse which represents the letter character. With respect to time, the low amplitude (letter) pulse is transmitted before the high amplitude (figure) pulse. Another function of the sharpener tube is to distinguish between these letter and figure pulses.
- j. When bias on the sharpener tube is high, the low amplitude pulse cannot fire the tube and this pulse has no further effect on the circuit. The high amplitude pulse, however, which is

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

transmitted next, is sufficient to overcome the bias and action is initiated for the printing of the figure character. On the other hand, had the bias on the sharpener been low, the low amplitude pulse would have fired the tube and the letter character would have been printed. Of course, the high amplitude (figure) pulse would still have been transmitted but it would have had no effect on the sharpener tube because of the time required for the tube to recover after firing on the low amplitude pulse.

- k. It is the function of the shift tube to vary the bias on the sharpener tube so that either figure pulses or letter pulses are selected. When the shift tube, which is a type 2D21 thyratron, is not conducting, the bias on the sharpener tube becomes less negative, thus permitting letter pulses to initiate printing. Conversely, when the shift tube is conducting, bias on the sharpener tube becomes more negative and only figure pulses can initiate printing. When the shift tube conducts, a neon lamp (fig. 2) glows to provide a visual indication that the machine is set for figure operation.
- l. After the sharpener tube selects a pulse, and transmits it to the print tube during the interval when the gate voltage is present at the shield grid, the print tube fires and the print and trip magnets are energized. This initiates the following mechanical action.
- m. Approximately 2 milliseconds after the print magnet has been energized, the print hammer presses the tape and inked ribbon against the print wheel at the precise moment in which the selected character reaches the print position. The print hammer is so designed that the speed imparted by the electromagnet is amplified mechanically by reed springs (see subpar. 4006b(1)(e)). Therefore, the hammer strikes harder and faster, and retires more quickly than it would if the print magnet employed a conventional armature pivot. The swiftness of the print hammer insures the printing of clean, sharp characters on the paper tape.
- n. The print and trip magnets are energized simultaneously. After a 3 millisecond mechanical delay, the trip magnet armature trips the clutch pawl carrier, thereby permitting the clutch pawl to engage the clutch drive assembly ratchet, which rotates at a speed of 600 rpm as long as the machine is turned on. This sets the timing cam shaft in motion and initiates the timing cycle actions.
- o. The four timing cams open and close four switches, the individual functions of which are as follows:
  - (1) The letters cam switch controls the enciphering and deciphering of the letter function.
  - (2) The figures cam switch controls the enciphering and deciphering of the figure function.
  - (3) The repeat cam switch serves as an interlock to prevent multiple cycling.
  - (4) The charge cam switch insures fast machine operation by a rapid restoration of power to the print control circuit.
- p. Rotation of the timing cam shaft also actuates the rotor stepping drive mechanism (through a miter gear, which is fastened to the cam shaft, and an eccentric crank assembly) and the ribbon and tape feed drive mechanisms. The rotor stepping mechanism actuates a mechanical counter which tallies the number of stepping operations. The tape and ribbon feed drive mechanisms provide spacing between words when deciphering, produce five-letter groups when enciphering, and automatically reverse the ribbon.

**2104. Timing Cycle (fig. 9).**—Each key depression initiates two phases of operation—the printing phase and the stepping phase. The time required to complete the printing phase is variable and may be anything from a minimum of 13 milliseconds to a maximum of 39 milliseconds. The time required to complete the stepping phase is constant at 100 milliseconds. The actions involved may be diagrammed as in figure 9, and explained briefly as follows:

- a. *Printing Phase.*—The minimum time required for the printing phase is determined by the recovery time (11 milliseconds) of the sharpener tube, plus the 2 ms required for the print hammer to strike. The varying time intervals; up to a maximum of 39 ms, are determined

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

by the position of the pulse generator rotor in relation to the selected coil at the instant of key closure.

For example, if a pulse is received at the sharpener tube 10 ms after key closure, the sharpener tube would not be fully recovered (and hence would not fire) so action would have to wait the next pulse, which would arrive 27 ms later. Thus, the maximum time required is  $10+27+2=39$  ms. Assuming that the desired pulse is received 25 ms after key closure, the sequence of operations for the printing phase would be as illustrated in sections B through H of figure 9.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

### CHAPTER 3 EMPLOYMENT

#### 3000—PREPARATION FOR USE

**3001. Unpacking Procedure.**—Use the following procedure to unpack TSEC/KL-7:

- a. Place the carrying case right side up and remove the metal shipping band.
- b. Unfasten the six cover-holding latches (fig. 1) and remove the cover by raising it vertically.
- c. Tip the case downward to its operating position (fig. 1) and fasten the cover to the case as follows:
  - (1) Place cover on the case as illustrated in figure 1.
  - (2) Press down slightly on the Dzus fasteners and turn them in a clockwise direction until the catch is engaged. This should be within one quarter of a turn.
  - (3) If the fastener is properly engaged, it will be snug and the cover will be attached securely to the case.

**3002. Inspection Procedure and Damage Report.**—Examine for damage in shipment and remove the equipment inspection tag if still attached. All cases of damage during shipment will be reported to the office of issue through normal Service channels. The report shall include:

- a. The register numbers of KLA-7/TSEC and KLK-7/TSEC.
- b. The date of receipt.
- c. The name and address of the unit or organization from which the equipment was received.
- d. A brief outline of the damage.
- e. A statement that local maintenance personnel were capable of repairing the damage and placing the equipment in operating condition, or that the equipment is still inoperative because local maintenance personnel were not available or were not able to repair the damage.
- f. When a report is submitted in writing, enclose the equipment inspection tag, if available.

*Note:* Navy holders shall report cases of damage in accordance with regulations prescribed by the Bureau of Ships.

**3003. Installation of Equipment.**—Following the initial inspection of the equipment, TSEC/KL-7 is to be prepared for operation in the following manner:

- a. *Cleaning and Lubrication of Rotors.*—Thoroughly clean the surfaces of the flat-head contacts, (fig. 4) using the CE 87296 eraser provided in the accessories kit. Clean the pressure contacts by polishing them with the canvas cleaning block assembly.
  - (1) Apply a generous coating of Quietone (Part No. CE 87297) to the flat head contacts and to the ground surface of the rotor core. The ground surface of the core may be described as the nonglossy section of the bakelite into which are set the flat head contacts. As a rule of thumb, apply three coatings of Quietone to the area thus described to assure a "generous" application. Spread the Quietone evenly after each application and allow it to dry.
  - (2) No definite time schedule is established for relubrication of the rotors since this is dependent upon operating conditions. However, when the rotors become dirty or dry, repeat the cleaning and lubricating procedures.
  - (3) Do not use chemicals to clean the rotors or any other plastic parts. They might have an injurious effect on the material.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

- b. *Placement of Rotors.*—The rotors are to be placed in the cipher unit assembly shell so that when the cipher unit is completely assembled the pressure contacts of all rotors will face toward the right-hand end plate assembly.

*Note:* See subparagraphs 7103a and 7104e for instructions regarding the removal and replacement of the cipher unit.

- (1) Place the first three rotors on the shaft in their proper sequence, and slide them into the shell.
- (2) Next, place the stationary rotor on the shaft, and position it so as to align its tabs with the two machined keyways in the shell. One of these keyways is wider than the other, thereby insuring proper alignment.

**CAUTION: THE STATIONARY ROTOR MUST BE PLACED IN THE CIPHER UNIT SO THAT IT IS THE FOURTH FROM THE LEFT. IF THE MACHINE IS OPERATED WITH IT IN ANY OTHER POSITION, SERIOUS DAMAGE TO THE EQUIPMENT WILL RESULT.**

- (3) Place the remaining four rotors on the shaft in their proper sequence, and slide them into the shell. Normally, the last rotor will project slightly beyond the edge of the shell until the end plate is put into position.
  - (4) Place the right-hand end plate assembly on the shaft, and compress the rotors into the shell until the right-hand end plate latch can be engaged in the machined groove on the rotor shaft, thus locking the rotors within the shell.
  - (5) The end plate assemblies of the cipher unit extend through the stepping unit and make connection with pressure contacts on the contact panel. *Be careful so that these contacts and the end plate assemblies are not damaged during removal or installation of the cipher unit.*
- c. *Installation of Typewriter Ribbon (fig. 10).*—The typewriter ribbon is contained on two metal spools. It is fed down and around the figured wheel in the ribbon track. Initial installation of the ribbon may differ from the normal operating trackage because of the direction in which the ribbon is wound during manufacture. The driving action of the mechanism is such that the winding spool rotates counterclockwise. The ribbon reversing mechanism is so designed that after the ribbon has been completely unwound from the new spool, the normal route of the ribbon will be assumed automatically. The ribbon is normally unwound from the top right of the left-hand spool, and travels down around the ribbon track and up to the top right of the right-hand spool. The new ribbon is installed in the following manner:
- (1) Remove the ribbon dust cover.
  - (2) Raise the latches of the two ribbon spools and withdraw the spools from the shafts of the reel drive plates. Disconnect the ribbon from the empty spool.
  - (3) Unwind approximately 8 inches of ribbon from the new full spool, and attach this spool to the left drive plate.
  - (4) Attach the free end of the new ribbon to the empty metal spool. The ribbon should be threaded onto this spool from the top right. Be certain that the free end of the ribbon is passed through the hub of the spool and up onto the serrated teeth so that the ribbon is pierced by the serrated teeth. In this manner, the pull of the ribbon is constantly against the serrated teeth, and will not loosen when the end of the ribbon is reached and the direction of travel reversed. Attach the empty spool to the right reel drive plate.
  - (5) Rewind any excess slack in the ribbon onto the free-running spool.
  - (6) Replace the ribbon dust cover.
- d. *Installation of Paper Tape.*—The roll of paper tape is housed in the paper tape container (fig. 3) at the right side of the printer assembly. It is positioned under the figured wheel by

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

means of a guide block and paper tape guide. The roll of paper tape is installed in the following manner:

- (1) Release the spring hood assembly by turning the swivel pin assembly 90 degrees. Restrict the upward travel of the spring hood with the right hand.
- (2) Flatten the roll of tape by tapping it against the carrying case or any other flat object.
- (3) Tear off the first wrap of tape and discard it. Unroll approximately 1 foot of tape.
- (4) Place the roll of tape between the sides of the paper tape container so that the end of the tape comes off the bottom of the roll with the gummed side up.
- (5) Depress the roll of tape into the paper tape container, and secure the spring hood assembly by means of the swivel pin assembly.
- (6) Form the free end of the tape around the guide block of the paper tape container, and pull the tape until it is taut and extends past the paper tape feed roll (fig. 3).
- (7) Hold the tape around the guide block and thread the end of the tape through the paper tape guide, with the gummed side of the tape down.
- (8) Push inward against the feed roll follower assembly (fig. 3), and slide the tape between the paper tape feed roll and the feed roll follower. Release the feed roll follower assembly, allowing it to ride on top of the paper tape feed roll, thereby holding the tape in place.
- (9) Check the tape to see that it is smooth and unwrinkled. Push inward against the feed roll follower assembly, and take up any slack in the tape. Release the feed roll follower assembly and tear off the excess tape by grasping the loose end and pulling upward and outward with a sharp motion.

*Note:* To prevent the paper tape from unraveling in transit, moisten its loose end and affix it to the roll of tape.

- e. *Connecting Power Supply.*—TSEC/KL-7 is designed to operate from a voltage supply of 21 to 31 volts DC. The source of the power must be checked to see that it is capable of supplying 2.5 amperes over the specified voltage limits. After checking the power, connect TSEC/KL-7 to the power source by means of the power cable.

**WARNING:** WHEN TSEC/KL-7 IS OPERATED IN A VEHICLE, PROLONGED USE WHEN THE ENGINE IS NOT RUNNING WILL RAPIDLY DRAIN THE BATTERY AND CAUSE INTERMITTENT OPERATION OF THE CIPHER MACHINE AND POSSIBLE INABILITY TO START THE VEHICLE.

**3004. Test Procedure.**—The test procedure described below is to be used to check the operation of TSEC/KL-7 following initial set-up of the equipment and any prolonged period during which the cipher machine has not been operated. It may also be used for the diagnosis of trouble in the equipment. While not infallible, it will, in the majority of cases, localize trouble to major components. The test is designed to check the cipher machine operation only, not a particular group of rotors. The test sequence listed below must be followed, or the trouble chart in paragraph 3101 will not apply. The procedure is arranged so that once a component has been checked for proper operation it may be eliminated as a possible source of trouble in any subsequent test steps. During the test, as during the normal operation of the cipher machine, typing at speeds in excess of 60 words per minute will result in malfunctioning of the equipment and the dropping of characters in the reproduced text. In the event that improper results are obtained during any of the following test steps, refer to paragraph 3101 for the appropriate trouble-shooting procedures.

- a. *Plain Text.*—With the external power supply connected to TSEC/KL-7, turn the selector handle from the O (off) to the P (plain) position. The motor generator will start and run continuously, and the figured wheel will rotate in a clockwise direction as viewed from the front. Wait approximately 15 seconds for the tubes to warm up.

- (1) Depress the FIG key. The neon glow lamp (fig. 2) should light.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (2) Depress the LET key. The neon glow lamp should go out.
- (3) Set the counter (fig. 4) to zero.
- (4) Type the the following test sentence: THE 236TH QUICK RED FOX JUMPED 780 TIMES OVER 1459 LAZY BROWN DOGS. The reproduction on the paper tape should be the same, and the counter should register 66.
- (5) Mark this part of the paper tape #1.
- (6) Depress the L key and then the RPT key. The machine should print a continuous line of L characters in a rhythmical manner. There should be no blank character spaces between the L's.
- (7) Depress one of the seven set keys (fig. 4).
  - (a) Hold the set key depressed. Its associated rotor should step continuously in a rhythmical manner.
  - (b) Momentarily depress and release the set key. The associated rotor should step one position only.
  - (c) Repeat steps (a) and (b) above until the rotor has completed three revolutions.
- (8) Repeat the steps in subparagraph (7) above for each of the six remaining set keys.

*b. Operation.*

- (1) With the selector handle in the P position, set each of the seven rotors to A by means of their respective set keys.
- (2) Turn the selector handle from the P to the E (encipher) position.
  - ✓(a) The cipher machine should cycle once.
  - (b) The paper tape mechanism should feed the paper tape one space.
  - (c) There should be no printing on the paper tape.
  - (d) At least three of the rotors should step one position.
- (3) Set the counter to zero.
- (4) Depress the L key and then the RPT key, and hold them depressed until the counter registers 1000. The cipher machine should print 200 groups of 5 letters each.
- (5) Mark this part of the paper tape #2.
- (6) Note the reading of the seven rotors with reference to the cipher unit index marks on the shell (fig. 4). Write this reading on the end of tape section #2.
- (7) Turn the selector handle from the E to the P position. The machine should cycle once.
- (8) Repeat steps (1) through (4) above.
- (9) Mark this part of the tape #3.
- (10) Compare the reading of the seven rotors with that obtained in step (6) above. They should be identical.
- (11) Compare paper tapes #2 and #3. They should be identical.
- (12) Turn the selector handle from the E to the P position.
- (13) Repeat steps (1) through (3) above.
- (14) Type the sample sentence given in subparagraph a(4) above. The cipher machine should print 14 five-letter groups with a group of two letters at the end. The glow lamp should light each of the three times the FIG key is depressed, and go out each time the LET key is depressed. The counter should register 72.
- (15) Mark this part of the paper tape #4.

*c. Operation.*

- (1) Turn the selector handle from E to the P position.
- (2) Repeat steps (1) through (3) in subparagraph b above, except that in step (2) turn the selector handle from the P to the D (decipher) position.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

- (3) Type the enciphered version of the test sentence as reproduced on the tape marked #4. Note that the space bar does not function in the D position. The glow lamp should go on and off three times during the typing. The cipher machine should reproduce the test sentence in subparagraph (4) below.
- (4) THE--236-TH-QUICK-RED-FOX-YUMPED--780--TIMES-OVER--1459--LAXY-BROWN-DOGS

Note: A dash (-) represents one space.

- (5) The counter should register 72.

d. *Conclusions.*—If the correct results are obtained for each of the foregoing tests, the cipher machine is operating correctly.

**3005. Operational and Functional Errors.**—The two classes of errors which may cause the cipher machine to function incorrectly are designated as operational errors and functional errors.

- a. *Operational Errors.*—Operational errors are those due to mistakes made by the operator, either in setting up or in operating the equipment. They can be largely eliminated by the exercise of proper care on the part of the operator.
- b. *Functional Errors.*—Functional errors are those which result from mechanical and electrical failures and may include such faults as improper adjustments, dirty contacts, shorted or open circuits, and power failures. If the operator cannot correct functional errors by replacing major component assemblies, the equipment should be sent through normal Service channels to a higher echelon for the necessary repairs. Rotors should be cleaned and lubricated in accordance with the instructions in subparagraph 3003a before being used.

**3006. Installation of the KLX-7/TSEC Keyboard Adapter on the TSEC/KL-7.**

a. *Purpose.*—The purpose of the KLX-7/TSEC keyboard adapter is to transfer the output of the TSEC/HL-1 tape reader to selected key circuits in the TSEC/KL-7 cipher machine. This permits the TSEC/KL-7 cipher machine to be operated by means of a standard teletypewriter tape.

b. *Installation of KLX-7/TSEC.*

- (1) Remove the keyboard from the TSEC/KL-7 as follows:

- (a) Disconnect power.
- (b) Turn the selector handle to the D position.
- (c) Loosen the five captive screws that secure the keyboard to the contact panel. Pull off the keyboard. Make certain that the sliding contact board remains in place on the contact panel.
- (d) Remove the five standoffs.

- (2) Install the KLX-7/TSEC Keyboard Adapter as follows:

- (a) Make certain that the cam on the sliding contact board is to the left of the follower.
- (b) Place the KLX-7/TSEC onto the contact panel with the plug receptacle forward and the flat head contacts face up. Make certain the selector handle extension engages the notch in the contact board.
- (c) Secure the KLX-7/TSEC to the contact panel by tightening the screw inside of each of the five hex nuts.
- (d) Place the five standoffs (beveled edges down) into the sockets in the five hex nuts.
- (e) Test to determine whether the KLX-7/TSEC is correctly mounted. The selector handle extension should have a heavy and positive action, and the KLX-7/TSEC, itself, should be springy.
- (f) Take the keyboard and back off its five captive screws into the chassis.
- (g) Mount the keyboard on the KLX-7/TSEC so that the five captive screws fit firmly into the five standoffs and tighten the screws.
- (h) Press the plug on the adapter cable into its plug receptacle. (The pins on the plug are offset to insure the correct insertion of the plug.) Secure the plug by means of its clamp.
- (i) Connect the TSEC/KL-7 to its power source.

c. *Testing.*—Prepare a test tape and test the operation of the TSEC/KL-7 with the TSEC/HL-1 as prescribed in paragraph 3004 of AFSAG 1207B, "Repair and Maintenance Instructions for AFSAZ 7301."

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

## 3100—TROUBLE SHOOTING

3101. **Simplified Trouble-Shooting Chart.**—Following is a simplified trouble-shooting chart to be used in conjunction with the test procedures outlined in paragraph 3004. Its main purpose is to associate troubles which may be disclosed by the test procedures with the major component most commonly responsible. The troubles and remedies are listed by the paragraph number of the test procedures which will disclose them.

*Reference  
Paragraph*

*Trouble And Remedy*

3004a.....Motor does not operate

1. Check power cable terminal connections
2. Check and replace fuses if defective
3. Check and replace power supply if defective
4. Check and clean contacts under keyboard assembly
5. Check and clean contacts on each side of the sliding contact board
6. Check and clean contacts under printer assembly
7. Replace assemblies which have defective contacts
8. Replace printer unit
9. Replace keyboard assembly
10. Replace sliding contact board
11. Replace contact panel assembly

Motor runs too fast

1. Replace printer assembly
2. Check and replace power supply if defective

3004a(1)..... Neon glow lamp does not light

1. Replace neon glow lamp
2. Replace shift tube (See note at end of chart.)
3. Check and clean contacts under keyboard assembly
4. Check and clean contacts on each side of the sliding contact board
5. Check and clean contacts under printer assembly
6. Replace components which have defective contacts
7. Replace printer assembly
8. Replace contact panel assembly

3004a(2)..... Neon glow lamp does not go out

1. Replace shift tube (See note at end of chart.)
2. Check and clean contacts under keyboard assembly
3. Check and clean contacts on each side of the sliding contact board
4. Replace keyboard assembly
5. Replace sliding contact board
6. Replace contact panel assembly

3004a(3)..... Counter does not reset

Replace stepping unit

3004a(4)..... No printing on tape

1. Replace print tube (See note at end of chart.)
2. Replace sharpener tube (See note at end of chart.)
3. Replace gate tube (See note at end of chart.)
4. Replace printer assembly

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

5. Replace keyboard assembly
6. Replace sliding contact board
7. Replace contact panel assembly

## Poor quality of printing

1. Replace print and sharpener tubes (See note at end of chart.)
2. Replace printer assembly
3. Replace contact panel assembly

## Dropped characters (did not print)

1. Check and clean contacts under keyboard
2. Check and clean contacts on each side of the sliding contact board
3. Check and clean contacts under printer assembly
4. Replace components which have defective contacts

## Numerals do not print

1. Replace printer assembly
2. Replace contact panel assembly

## No spacing on tape

Replace printer assembly

## Poor spacing on tape

1. Check paper tape for sticking
2. Flatten paper tape roll
3. Replace printer assembly

## Letters print instead of numerals

1. Replace shift tube (See note at end of chart.)
2. Replace printer assembly
3. Replace contact panel assembly

## Repetitive printing or spacing

1. Replace gate tube (See note at end of chart.)
2. Replace printer assembly

## 3004a(6).....Prints one character only and stops

1. Check and clean contacts under keyboard assembly
2. Check and clean contacts on both sides of the sliding contact board
3. Replace unit which has defective contacts
4. Replace contact panel assembly

## Repeats in a non-rhythmic manner

1. Replace printer assembly
2. Replace contact panel assembly

## 3004a(7)(a)...Rotor or rotors do not step

1. Check and clean contacts under stepping unit
2. Check and clean contacts under printer assembly
3. Replace units which have defective contacts
4. Check rotors
5. Replace stepping unit

## 3004b(2).....Machine fails to make automatic cycle

1. Check and clean contacts under keyboard assembly
2. Check and clean contacts on each side of the sliding contact board
3. Replace unit which has defective contacts

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

4. Replace keyboard assembly
5. Replace sliding contact board
6. Replace contact panel assembly

3004b(2)(d)...No rotors step

1. Check and clean contacts under keyboard assembly
2. Check and clean contacts on both sides of contact board
3. Replace unit which has defective contacts
4. Replace stepping unit

Only one rotor steps

Replace stepping unit

3004b(4).....No printing or stops printing before count is reached

1. Check and clean contacts under cipher unit
2. Check and clean contacts under stepping unit
3. Check and clean contacts of all rotors and apply Quietone
4. Check and clean contacts of end plate assemblies
5. Replace units which have defective contacts
6. Replace cipher unit
7. Replace stepping unit

Does not print five-letter groups

1. Replace printer assembly
2. Replace keyboard assembly
3. Replace sliding contact board

3004b(10)....Rotors do not agree

1. Replace stepping unit
2. Replace cipher unit

3004b(11)....Tapes do not agree

1. Replace stepping unit
2. Replace cipher unit

3004b(14)....Seventy-two characters not printed

1. Retype sentence
2. Check and clean contacts under cipher unit
3. Check and clean contacts under stepping unit
4. Check and clean contacts between cipher unit and rotor stepping unit
5. Replace units which have defective contacts
6. Check, clean, and apply Quietone to contacts of all rotors
7. Check and clean contacts under keyboard
8. Check and clean contacts on each side of the sliding contact board

Neon glow lamp does not light when FIG key is depressed

1. Check and clean contacts under keyboard assembly
2. Check and clean contacts on each side of the sliding contact board
3. Replace unit which has defective contacts
4. Replace printer assembly

Neon glow lamp lights but machine does not print

Replace printer assembly

Neon glow lamp does not go out when LET key is depressed

Replace printer assembly

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

3004c(3).....Does not decipher

1. Reset rotors and retype enciphered version
2. Replace stepping unit
3. Replace cipher unit

Letters and numbers garbled

1. Replace printer assembly
2. Replace stepping unit
3. Replace cipher unit

*Note:* Because of normal differences in tube characteristics, operational peculiarities may occur after installing new electron tubes. In fact, some tubes will work in one TSEC/KL-7, but not in another. It may be necessary, therefore, to try several tubes of the same type before one is found which will give completely satisfactory service in TSEC/KL-7.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## CHAPTER 4 THEORY

### 4000—PHYSICAL DESCRIPTION AND MECHANICAL THEORY

**4001. General (fig. 1).**—TSEC/KL-7 is composed essentially of the following major assemblies: a base, keyboard, sliding contact board and guide rail, contact panel, printer, rotor stepping unit, and cipher unit. All of these assemblies are removable as units. Physical descriptions and mechanical theory of each follow:

**4002. Base (fig. 1).**—The base forms the supporting frame upon which all other machine components are mounted.

- a. Machined tracks on all four sides, the bottom, and the top of the two side-frame brackets provide a means of shock mounting the cipher machine into its carrying case.
- b. Four threaded Rosan inserts in the base provide a means to mount the cipher machine in a specially designed office case (see subpar. 2102j).
- c. Pads, abutments, and Rosan inserts provide the means of supporting and mounting other machine components on the base.
- d. Two spring-loaded stop pins, protruding from the underside of the base, engage the spring stop in the carrying case and provide two stop positions for the cipher machine. One stop position permits the machine to be pulled out to the operating position, i. e., to a point where the keyboard is accessible to the operator. The second stop position permits the cipher machine to be pulled out further so that the operator has access to the cipher unit without the danger of unintentional withdrawal.

**4003. Keyboard Assembly (fig. 11).**—Besides serving the function of a standard typewriter keyboard, this assembly provides: (1) a means of external electrical input to the cipher machine, and (2) serves as a four position multicircuit switching device in conjunction with the sliding contact board and guide rail assembly.

- a. *Keyboard Function.*—There are 29 key switch assemblies mounted in the keyboard, twenty-six of which represent characters and numerals, and three of which provide the means for introducing the figure, letter, and repeat functions into the cipher machine. There is, in addition, a space bar which introduces the spacing function.
  - (1) Each key switch and the space bar act as the pole of a single-pole, single-throw switch.
  - (2) All key switches are identical in construction (see fig. 11) except the RPT key switch, which has a heavier compression spring. This prevents double cycling caused by accidental brushing of the fingers against the RPT key switch. A rubber bellows surrounding each key switch protects it from dust. A leaf spring riveted to the keyboard chassis under the plastic space bar provides correct tension for the space bar.
  - (3) Common for all key switches and the space bar is provided through a silver plated common plate. Each key switch is in direct contact with this plate while the space bar is connected to it through a wire and lug assembly (see fig. 11).
  - (4) The common plate terminates at one electrical point termed the "common post." The common post protrudes down through a clearance slot in the sliding contact board and guide rail assembly to a pressure contact on the contact board. This is the connection from the common side of the keyboard to the rest of the cipher machine.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

(5) Depression of any key switch or the space bar mates the silver-tipped end of the selected key switch with the contact on the sliding contact board underneath the key switch. This completes a circuit from common (which is one side of the key switch) through a coil in the pulse generator.

b. *Power Input Function.*—A power cable passes through a strain relief bushing into the keyboard chassis. One end of the cable is fitted with an Amphenol plug. The other end has two terminal lugs which are secured to terminals on the power switch assembly by two screws. The terminals are connected through the fuses to leaf springs which apply power to the machine through the sliding contact board and guide-rail assembly.

*Note:* The red wires represent the positive leads of the power input; the black represent the negative. The negative and positive terminals are designated in the Amphenol plug by embossed letters, A (positive) and B (negative).

c. *Multicircuit Switching Function.*

(1) The function selector handle (fig. 11) moves the sliding contact board and guide-rail assembly to any one of four operating positions. These four positions are: O (off), P (plain text), E (encipher), and D (decipher).

(2) Turning the selector handle from one position to another turns a radius arm mounted to the selector handle assembly on the underside of the keyboard chassis. The radius arm fits into a slot on the sliding contact board and, when the selector handle is moved from the O position to either the P, E, or D position, the radius arm pulls the sliding contact board to the left, shifting it to the particular operating position desired.

(3) The selector handle assembly is detented by a compression spring and ball bearings which exert continuous pressure against the scalloped housing assembly. This insures positive action when switching from one operating position to another.

*Note:* See paragraph 4002 for description of KAX-1/TSEC Keyboard Adapter.

4004. *Sliding Contact Board and Guide Rail Assembly* (fig. 12 and 13).—The sliding contact board and guide rail assembly lies directly below the keyboard assembly and above the forward area of the contact panel assembly. This assembly, working in conjunction with the keyboard (see subpar. 4003c), serves as a four-position multiswitching device.

a. *Sliding Contact Board Assembly.*—The sliding contact board assembly consists of a phenolic fiber board into which are set 74 silvered contacts. These contacts are of three types: single T-shaped contacts, double T-shaped contacts, and connecting bars. The single and double T-shaped contacts pass entirely through the contact board, providing contact areas on both sides of the board. The connecting bars have contact areas on the lower face of the board only.

(1) *Double T contacts.*—In the three operating positions these two contacts align with the leaf contacts of the power switch assembly above, and with pressure contacts on the contact panel below. This closes the circuit through which power is applied to the cipher machine. In the O position of the selector handle, the double T contacts do not mate with the leaf contacts and the power circuit is open.

(2) *T and connecting bar contacts.*—The majority of the T and connecting bar contacts are aligned under the three rows of key switches. A fourth row of connecting bar contacts, plus a few other contacts, comprise the sections for circuit switching.

*Note:* One of the T contacts is modified to the extent that it has an additional leg on the right side. This gives it two contacting surfaces on the bottom side of the panel instead of one. This T contact operates only in conjunction with the RPT (repeat) key switch in the P and E position. (See actual wiring diagram, fig. 61).

(a) In the P position (fig. 16-A), if a key is depressed, its contact mates with the center of a T contact below it. Through the leg of the T contact a circuit is established to

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

the center one of a group of three pressure contacts located below that key on the contact panel.

- (b) In the E position (fig. 16-B), the sliding contact board has been shifted to the left so that the depressed key contact will touch the right end of the same T contact. This completes the key circuit to the left member of the group of three pressure contacts; the connecting bar contact to the right of the T contact will link together the center and right-hand pressure contacts.
  - (c) In the D position (fig. 16-C), the sliding contact board has been shifted two positions to the left so that the depressed key switch contact will touch the left end of the adjacent T contact. Through the leg of that T contact the key circuit will be completed to the right-hand member of the group of three pressure contacts. At the same time, a connecting bar links together the left-hand and center pressure contacts.
- b. *Guide Rail Assembly.*—The guide rails on the sliding contact board facilitate the lateral movement of the contact board assembly over the pressure contacts. This is accomplished by rollers which permit the assembly to ride easily along the tracks on the underside of the keyboard chassis.
- c. *Follower Actuating Cam.*—When the selector handle is moved to the E position, the cam at the left end of the rear edge of the sliding contact board actuates the follower assembly. This results in automatic five-character grouping (see subpar. 4006d.)

**4005. Contact Panel Assembly.**—The contact panel assembly is attached directly to the cipher machine base. It provides the interunit wiring of the cipher machine, contains the fixed contacts that establish the interunit connections, carries the various electrical circuit components, and is the mounting base to which the keyboard is secured.

- a. *Contact Panel.*—The phenolic contact panel mounts the following items: Six-tube sockets in a row along the rear edge, to receive four tubes used in the cipher machine, plus two spares; a transformer; a lamp socket assembly for the neon glow lamp; the operator's light socket assembly; and the follower assembly near the upper left-hand corner of the keyboard area. Set into the panel are 175 pressure contacts, 52 flathead contacts, and sufficient turret lugs to serve as tie points between the electrical components located on the lower surface of the contact panel.
- b. *Contacts and Turret Lugs.*
  - (1) There are 173 light-duty pressure contacts and two heavy-duty pressure contacts on the panel. The difference between the two types lies in the fact that the heavy-duty contacts have a larger current-carrying capacity than the light-duty contacts. The two heavy-duty contacts are used in the power input circuit, where contacts capable of handling a reasonably heavy current are required.
  - (2) The flathead contacts on the contact panel mate with pressure contacts on the printer unit.
  - (3) The electrical components whose connections are on the underside of the contact panel include 32 resistors, 19 capacitors, 20 crystal diodes, and a transformer. These components are secured to the contact panel by means of the turret lugs. These turret lugs also serve as electrical tie-points between components.

*Note:* Since turret lugs, pressure contacts, and flathead contacts are all accessible from the top side of the contact panel, continuity checks and various voltage readings may be made without removing the panel from the base. (See fig. 58 for physical location of electrical components and voltage readings at various points.)

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

**4006. Printer Assembly.**—The printer assembly provides the machine with high voltage for plate and bias supplies in addition to providing the necessary facilities for printing and spacing of the paper tape and inked ribbon. These functions are accomplished through the following components.

*a. Motor-Generator and Controller Assembly (fig. 20).*

(1) **Motor-Generator.**—The motor furnishes the machine with necessary mechanical power while the generator output, rectified through a full-wave diode rectifier located on the contact panel, provides the high DC voltages required for plate and biasing purposes in the electronic circuits. Both motor and generator are contained in a single housing with a common shaft between them.

(a) **Motor and generator specifications.**—Based on a 24-volt DC input (the complete range extends from 21 to 31 volts DC) the motor should turn at 6600 rpm and develop  $\frac{1}{10}$  hp. The 400-cycle AC generator output at this motor speed should be 5 watts of power at 150 volts rms.

(b) **Mechanical linkage of the motor.**—A helical pinion gear, mounted on the external end of the shaft, links the mechanical torque of the motor to other machine components. The helical pinion gear also turns the pulse generator rotor (fig. 29).

(2) **Controller.**—To govern variations in motor speed, a controller unit is provided. This controller consists of a 25-ohm (maximum) adjustable resistor, R202, and negative coefficient resistor R201. Both resistors are in series with one another and with the motor field.

(a) In a shunt wound DC motor, such as the one used in TSEC/KL-7, the amount of cemf (counter electromotive force) built up by the field controls the speed of the motor. The more cemf generated, the greater the reactance between the field and armature windings, with a resultant decrease in motor speed. Conversely, the less cemf generated, the faster the motor will operate. The amount of cemf generated by the field windings is proportionate to the amount of current in its circuit. The current, in turn, is inversely proportionate to the amount of resistance in the circuit.

(b) Therefore, if some means can be found to vary the resistance of the field circuit, the speed of the motor can be governed. Resistors R201 and R202 serve this function.

(c) Resistor R201 is a negative coefficient resistor which has a resistance of 30 ohms at 25 degrees C. The property of this resistor in regards to temperature reaction is exactly opposite to normal resistors. Normally, heat generated by current causes an increase in resistance. In resistor R201, however, the resistance decreases as the temperature increases.

(d) Resistor R202 is an adjustable resistor to compensate for small manufacturing variations in the field windings of the motor and the negative coefficient resistor. Moving the slider (fig. 20) to the right increases the circuit resistance and causes the motor to speed up. Moving the slider to the left has the opposite effect.

(3) **Electrical Input and Output.**—The motor input and generator output are provided through pressure contacts on the bottom of the controller.

*Note: See paragraph 4009 for detailed description of CE 88000 Motor-Generator and Controller Assembly.*

*b. Pulse-Generator and Associated Parts (fig. 21).*

(1) **General.**

(a) The pulse generator provides electrical pulses at such time as to permit a selected character on the rotating figured wheel to be in print position when the print hammer strikes.

(b) The principal components of the pulse generator and its associated parts are the pulse generator rotor, stator and contact, helical gear and pinion, print magnet, figured wheel, and the front and rear end bells to which all the components are attached. The pulse generator shaft drives the figured wheel to which it is attached.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

- (c) The pulse generator operates on the principle that a voltage is induced and current will flow in a closed circuit coil if a magnet is passed over it. To more specifically relate this principle to TSEC/KL-7, when a key switch is depressed a circuit for a selected coil is closed. When the rotor, which is a permanent magnet, passes this particular coil, a voltage is induced and current flows in the key circuit represented by that coil. Since only one key is depressed, circuits for all other coils remain open, and passing the rotor over these coils has no effect upon the electronic circuits of TSEC/KL-7.
- (d) The figured wheel rotates constantly at a speed of 2200 rpm. To "print-on-the-fly," the letter which is to be printed must be in print position simultaneously with the strike of the print hammer. Print position for the figured wheel is the position over the opening in the tape chute through which the print hammer strikes.
- (e) Electrical action, once initiated in the selected key coil, is instantaneous. The selected letter at such time must be in print position *minus* the mechanical time delay of the print hammer. This mechanical delay (the time it takes for the print hammer to strike) is approximately 2 milliseconds.
- (f) In figure 21-A, note that "pulse position" shows the Q on the figured wheel to be about 26 degrees off the "print position." At 2200 rpm the figured wheel will travel the 26 degrees in approximately 2 milliseconds. Observe also that in the drawing depicting the "print position," which is 2 milliseconds later, the character Q is passing through the print position just as the print hammer makes its strike, and Q is printed on the paper tape.

(2) *Detailed Description of Individual Components.*

- (a) Gear and pinion assembly.—The mechanical energy to turn the rotor shaft is provided through the gear and pinion assembly which is mounted on one end of the shaft and located in the gear housing (fig. 29). The motor gear, which is turning at 6600 rpm, meshes with the fiber gear on the gear and pinion assembly. Since the fiber gear is three times the size of the motor gear, it will turn once for every three revolutions of the motor gear. Thus, the rotor shaft in the pulse generator on which the figured wheel and the rotor are mounted turns at 2200 rpm.

*Note:* The action of the pinion gear is discussed in regards to the timing unit (see subpar. g).

- (b) Stator and contact assembly (fig. 22).—The stator of the pulse-generator contains the coils in which the electrical energy is generated. There are two stator assemblies in this generator. The front stator contains 19 coils, while the rear stator contains 18 coils and 1 vacant coil position. The coils of the front stator are positioned directly in front of the coils in the rear stator, and the individual coils in each stator are spaced 19 degrees apart except for the two coils in the rear stator between which there is a vacant space that separates these two coils by 38 degrees. Depression of any one of the alpha-numeric keys closes the circuit for both high- and low-pulse coils. Since the rotor moves clockwise and the low-pulse coil of each alpha-numeric combination is ahead of the high-pulse coil, i. e., the rotor will pass the low-pulse coil first, the low (5v) pulse is always transmitted before the high (10v) pulse. The high pulse follows 2.88 milliseconds later. This time difference is mechanically determined by the degree of separation between low- and high-pulse coils (always 38 degrees) and the speed of the rotor which should be 2200 rpm. All keys other than those listed in figure 22-B which are alpha-numeric keys, the V-key, and the space bar, utilize high-pulse coils only. The space bar and V key utilize a special arrangement which is termed the "V-space" pulse coils. The V-space pulse coils (see fig. 22-C) are similar to ordinary alpha-numeric pulse coils, the V coil being the low-pulse coil and the space coil being the high-pulse coil. The difference between the V-space

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

pulse coils and ordinary alpha-numeric coils is that a special junction is provided for the space bar between the V coil and the space coil. Therefore, as far as the key switch circuits are concerned, the V key utilizes the complete alpha-numeric arrangement of the V-space coils, while the space bar uses only the high-pulse coil portion of the combination.

(c) Rotor assembly (fig. 21).

1. The rotor assembly is basically a two-pole armature mounted on the shaft so that a  $9\frac{1}{2}$ -degree angular displacement exists between the two poles. The rotor poles are separated by a plastic spacer which surrounds a cylindrical permanent magnet. Dynamic balance in the rotor is maintained by two copper slugs imbedded in the plastic spacer on the side opposite the rotor poles.
2. The coils of the front and rear stator assemblies are in line with each other (see subpar. (b) above). However, since the poles of the front and rear rotors are off-set  $9\frac{1}{2}$  degrees, a voltage is induced in only one coil at a time. This is illustrated in figure 22. The T coil is being pulsed by the front pole of the rotor while the Y coil, which is directly behind the T coil, is unaffected. Then, when the rotor turns  $9\frac{1}{2}$  degrees, the Y coil is pulsed by the rear pole and the T coil becomes inactive. Since the stator coils are approximately 19 degrees apart and the rotor poles are off-set by  $9\frac{1}{2}$  degrees, a voltage is induced every  $9\frac{1}{2}$  degrees of rotation.

- (d) Figured wheel (fig. 21).—The figured wheel, ring, and hub are attached to the forward end of the pulse generator rotor shaft. Three slotted holes in the hub provide a rotational adjustment of approximately 20 degrees. This adjustment provides the means for synchronizing the time relationship of the rotors and coils to the representative characters on the figured wheel. Although disassembly of the wheel and its associated parts reveals that the hub may be set on the figured wheel in any of three positions, it will be observed that in only one position will the slots in the hub be centered over the holes in the wheel. This provides a rough alignment of the figured wheel characters with their representative coils in the pulse generator. There are 36 raised characters and 2 blank spaces on the periphery of the wheel. These are spaced approximately  $9\frac{1}{2}$  degrees apart. Beginning with the character Q and running counterclockwise as viewed from the front, the character sequence is as follows (a dash (-) denotes a blank space):

QPWO1029EIRU3847TYZK56XHAGSFNDMCLBJV--

- (e) Print magnet assembly (fig. 21).—Unless the striking action of the TSEC/KL-7 print hammer is extremely sharp and quick, the figured wheel will have a tendency to drag over the paper tape and smudge the print. The print magnet for the cipher machine has been especially designed to assure the sharpest strike possible for the amount of current through its coil. By pivoting its armature on two reed springs instead of a conventional pin, mechanical action of the armature is speeded up. To obtain printing that is neither too heavy nor too light, the spacing between the print hammer and the figured wheel must be optimum. This spacing is controlled by the adjustment of the print magnet eccentric through which the striking height of the hammer may be lowered if printing is too heavy, or raised if printing is too light.
- (f) Tape feed tract (fig. 27).—The gummed tape for the machine is housed in a paper tape container. It is threaded, gummed side up, over a guide block which inverts the tape to gummed side down and turns it 90 degrees. As the tape leaves the paper tape container, the exposed gummed surface is protected from dust and other foreign matter by a preformed leaf spring. From the guide block, the tape is channeled through the tape feed guide. An opening in the tape feed guide permits the print hammer to strike the paper tape against the inked ribbon and figure wheel, thus

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

causing a character to be printed. From the tape feed guide, the tape is channeled between the paper tape feed roll and feed roll follower. The follower is spring-loaded so as to press the tape firmly against the knurled feed roll. This pressure against the tape permits the feed roll to advance the tape uniformly. A serrated cutting blade is provided for removing the printed portion of the tape, and a formed spring prevents the uncut tape from curling up under the cutting blade.

c. *Ribbon Reversing Mechanism (fig. 27).*—The purpose of this mechanism is to space the inked ribbon once for each machine operation and to reverse the direction of the ribbon when either spool becomes unwound.

(1) *Components.*—Individual components operate as follows:

- (a) *Tape and ribbon drive shaft spur gear.*—The tape and ribbon drive shaft is driven by the timing unit shaft. With every operation of the machine, the timing shaft cycles, moving the spur gear extension of the ribbon drive shaft in a counterclockwise direction. The spur gear meshes with the ribbon drive gear and drives it in a clockwise direction.
- (b) *Ribbon drive gear.*—An elbow-shaped shifting lever is attached to each side of the ribbon drive gear. One end of each lever is hooked to a common loading spring while the opposite ends are fastened together by the dual scallop gear. The scallop gear is tensioned against the inner teeth of the ring gears by the common spring, and provides the means to drive the front and rear ring gears. Both sides of the dual scallop gear are identical, but the gear is so constructed that the teeth of one side are exactly opposite the teeth of the other side. Thus, when the teeth of one side of the scallop gear are engaged with one ring gear, the teeth on the other side are not engaged.
- (c) *Front ring gear, left reel drive gear, and left ribbon spool.*—The front ring gear, when engaged by the scallop gear, drives the left reel drive gear. The left reel drive gear, in turn, winds the left ribbon spool. A compression spring is mounted over the reel drive gear to prevent too rapid unwinding of the left ribbon spool when it is unwinding.
- (d) *Rear ring gear, right reel drive gear, and right ribbon spool.*—The rear ring gear, when engaged by the scallop gear, drives the right reel drive gear. The right reel drive gear, in turn, winds the right ribbon spool. A compression spring is mounted over the reel drive gear to prevent too rapid unwinding of the right ribbon spool when it is unwinding.

(2) *General function.*—The force to drive the ribbon is applied from the tape and ribbon drive shaft spur gear through the ribbon reversing mechanism to one of the two reel drive gears. Only one of the metal spools is driven at one time. The other spool turns freely to let the ribbon unwind. When the ribbon is fully unwound, it draws taut and causes the ribbon reversing mechanism to transfer the driving force to the empty ribbon spool. This reverses the direction of ribbon feed. This automatic cycle is repeated each time the ribbon becomes fully unwound from one spool, and its action is completed within two operations of the cipher machine. In the following description, it is assumed that, at the start of operation, the left reel drive gear is being driven, causing the ribbon to be wound up on the left metal spool and to unwind from the right spool.

- (a) The teeth on the front side of the scallop gear are held in engagement with the internal teeth of the front ring gear by the tension of the spring. This pressure holds the elongated tooth on the front side of the scallop gear in mesh with an internal tooth on the front ring gear (fig. 28-A).
- (b) Each time a key is depressed, the tape and ribbon drive shaft spur gear turns the ribbon drive gear through an arc. The meshed elongated tooth drives the front ring

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

gear through a similar arc. The external teeth on the front ring gear drive the left reel drive gear which winds up the ribbon on the left metal spool. The rear ring gear (fig. 28-B) is not engaged by any of the teeth on the other side of the scallop gear. The pull of the unwinding ribbon causes the rear ring gear to turn freely on the rear face of the ribbon drive gear, and in the opposite direction. This action continues as long as the pull of the unwinding ribbon does not overcome the tension of the spring.

- (c) When the ribbon has fully unwound from the unwinding right spool, it pulls taut. The pull of the ribbon stalls the driving front ring gear. This prevents the meshed scallop gear tooth from following the rotation of the ribbon drive gear. As the ribbon drive gear continues to rotate in the same direction, the scallop gear is forced to roll over around the elongated tooth, stretching the spring and rotating on its own pivot (fig. 28-C and -D). When the scallop gear has rotated far enough, the elongated tooth (fig. 28-E) falls out of mesh. The spring tension pulls the rear set of teeth on the scallop gear into mesh with the internal teeth of the rear ring gear, and the rear elongated tooth (fig. 28-F) is brought into engagement.
- (d) With continuing rotation of the ribbon drive gear, the elongated tooth carries the rear ring gear around with it in the same direction. This in turn drives the right reel drive gear, and the ribbon starts to wind up on the right metal spool. The engaged scallop gear tooth is held in mesh by the spring, against the normal pull of the unwinding ribbon. It stays there until the other end of the ribbon is reached, at which time the driving action is changed back to the left spool in the same manner.

d. *Paper Tape Feed Mechanism.*—The purpose of this mechanism is to advance the paper tape one space for each machine operation in P and D operation, and to space the tape in groups of five characters in E operation. Individual components of the mechanism operate as follows:

- (1) *Tape and Ribbon Drive Shaft Eccentric (fig. 25).*—The tape and ribbon drive shaft is driven by the timing unit shaft. With every machine operation, the timing shaft cycles and the eccentric section of the tape ribbon drive shaft rotates counterclockwise. The rotation of the eccentric moves a yoke assembly in an oscillatory motion.
- (2) *Yoke Assembly (fig. 25).*—The yoke assembly is mounted on a pivot bushing and is free to oscillate with the rotation of the eccentric. This motion imparts a short downward and sharp upward travel to the pawl stud which is a part of the yoke assembly. This pawl stud (see fig. 25) contains the following components from rear to front:
  - (a) A single-drive ratchet pawl which initiates movement to advance the paper tape one space at a time.
  - (b) A double-drive ratchet pawl eccentric which increases or decreases the effective length of the double-drive ratchet pawl to assure correct functioning of the pawl.
  - (c) A double-drive ratchet pawl which initiates the movement to advance the paper tape an extra space after every fifth character in E operation. Both the double-drive and the single-drive ratchet pawls are tensioned against their respective ratchets by springs. These springs are mounted between the bottom end of the pawls and a special stud secured to the front end bell.
- (3) *Tape Feed Roll Drive Shaft (fig. 25).*—The paper tape feed roll is mounted on one end of the tape and feed roll drive shaft. It is this roll which provides the physical means to advance the paper tape either one or two spaces for a given machine operation. Either the single-drive ratchet or a combination of the double-drive, stop, and single-drive ratchets can advance the tape feed roll by rotating the tape feed roll drive shaft.
  - (a) *Single-drive ratchet assembly.*—The single-drive ratchet is mounted on a squared section of the tape feed roll drive shaft. Any rotation of this ratchet will move the shaft a corresponding distance. The single-drive ratchet has 24 teeth and is step-

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

ped by the single-drive ratchet pawl. Another feature of the single-drive ratchet assembly is its detent ratchet pawl. This is located on the flat side of the single-drive ratchet. Its shaft extends through to the other side and mounts the detent ratchet pawl lever. The detent ratchet pawl is held in engagement with the detent ratchet by the detent ratchet pawl spring.

- (b) **Stop ratchet and bushing assembly.**—The stop ratchet and bushing assembly is part of the mechanical linkage which serves to effect five-letter groupings in E position or to block five-letter groupings in D and P position. It includes a bushing and a four-tooth ratchet and links the double-drive ratchet to the single-drive ratchet as follows:
1. The stop ratchet is joined to the double-drive ratchet by a compression spring which is mounted on a holding stud on the stop ratchet, and a stop pin which fits into a slot on the double-drive ratchet.
  2. The stop ratchet is joined to the single-drive ratchet by the detent ratchet which is engaged by the detent pawl on the single-drive ratchet (see subpar. (a) above).
  3. The stop ratchet bushing provides a means of mounting the double-drive ratchet. The complete assembly, stop ratchet and double-drive ratchet, rotates on the rounded portion of the tape feed drive shaft.
- (c) **Double-drive ratchet assembly.**—The double-drive ratchet assembly consists of two four-tooth ratchets, one of which is approximately twice the diameter of the other. The double-drive ratchet is mounted on the stop ratchet bushing.
1. The larger diameter ratchet has two slots through which the stop pin and spring-holding stud of the stop ratchet protrude. The compression spring is set in one slot and, in effect, joins the stop and double-drive ratchets together. The stop ratchet stop pin rides in the other slot and limits the action of the compression spring by restricting the rotation of the double-drive ratchet to the extension of the slot. This pin positions the double-drive ratchet assembly for automatic five-character spacing.
  2. The smaller diameter ratchet is the ratchet which, when engaged by the double-drive ratchet, initiates the action to advance the paper tape two spaces.
- (4) **Pawl Shaft (fig. 25).**—The purpose of pawls on this shaft is to govern the movement of ratchets on the tape feed roll drive shaft. The components on the pawl shaft from rear to front are as follows:
- (a) **No-back pawl.**—The purpose of this pawl is to prevent overtravel of the single-drive ratchet and to insure uniform spacing of the paper tape.
  - (b) **No-back pawl eccentric.**—The eccentric regulates the effective length of the no-back pawl, providing a means for synchronizing the engagement of the no-back pawl and the single-drive ratchet pawl to the single-drive ratchet tooth.
  - (c) **Stop pawl.**—The stop pawl in P and D position prevents any movement of the double drive and stop ratchets. In E position, the stop pawl is disengaged from these ratchets and mechanical linkage is effected for five-letter grouping.
- (5) **Bracket Assembly (fig. 25-A).**—This assembly is part of the mechanical linkage necessary to disengage the stop pawl from the double-drive and stop ratchets during the enciphering operation.
- (a) As the selector handle is moved from P to E position, or from D to E, the cam on the sliding contact board depresses the follower on the contact panel assembly. The follower, in turn, depresses the plunger on the bracket assembly.
  - (b) The bracket assembly consists of the bracket and an eccentric stud which extends through the front end bell and holds one end of the no-back pawl spring. Integral with the bracket body are two post-like protrusions, one extending forward, and the

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

other extending back through the front end bell. The plunger is contained in the forward post and passes through the front end bell to contact the lever which is held on the other post with the pivot screw.

- (c) With the plunger depressed, it bears against the lower arm of the lever. The lever pivots on the pivot screw and rotates its top arm against the stop pawl. The pressure of the top arm of the lever overcomes the spring tension of the stop pawl and disengages the stop pawl from the stop and double-drive ratchets.
  - (d) This mechanical action occurs only when the selector handle is moved from either the P or D position to the E position. When the selector handle is moved from the E position to either the D or P position, the sliding contact board cam is disengaged from the follower, and the bracket plunger, bracket lever, and stop pawl return to their normal positions.
- (6) *General Function of Mechanism in P and D Position (fig. 26-A).*
- (a) In either P or D position, the following conditions exist in the mechanism:
    1. The stop pawl is engaged with the outer diameter of the double drive ratchet and with the stop ratchet. Neither of these ratchets, therefore, can rotate. The single-drive ratchet and the paper tape feed roll drive shaft, however, are free to rotate whenever induced by the single-drive ratchet pawl.
    2. With the double-drive ratchet engaged by the stop pawl, the small diameter of double-drive ratchet is in such position that the double-drive ratchet pawl cannot engage with the face of one of the ratchet teeth.
  - (b) When the machine is operated, the tape and ribbon drive shaft eccentric oscillates the yoke assembly. The single-drive and double-drive ratchet pawls travel downward and then thrust up with the oscillatory movement of the yoke. The travel of the pawls accomplishes the following:
    1. The single-drive ratchet pawl indexes the single-drive ratchet by one tooth. The ratchet, turning on the squared portion of the tape feed roll drive shaft, turns the feed roll and advances the paper tape one space.
    2. The double-drive ratchet pawl is mechanically ineffective against the double-drive ratchet.
    3. The no-back pawl prevents any movement of the single-drive ratchet during the downward movement of the single-drive ratchet pawl. This prevents the tape feed roll drive shaft from turning and avoids erratic spacing of the paper tape. During the upward travel, the single-drive ratchet pawl overrides one detent ratchet tooth and engages with the next.

(7) *General Function of Mechanism in the E Position.*

- (a) As the selector handle moves from the P to the E position, the following action takes place at some time previous to the automatic cycling of the machine (see fig. 26-B):
  1. The mechanical linkage between the contact panel cam and the top arm of the bracket lever disengages the stop pawl from the stop ratchet and double-drive ratchet. This permits the entire group of ratchets to rotate as a single unit whenever indexed by the single or double-drive ratchet pawls. This provides automatic five-character spacing.
  2. With the double drive and stop ratchets no longer blocked, the compression spring which joins them expands. The double drive ratchet rotates counterclockwise until the stop ratchet stop pin reaches the extent of its double-drive ratchet slot. The extent of this rotation is equal to two single-drive ratchet teeth. The detent pawl prevents the detent ratchet from rotating. Therefore the stop ratchet remains stationary during this action.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

3. The single-drive ratchet has 24 teeth while the smaller diameter section of the double-drive ratchet has only four teeth. Each double-drive ratchet tooth has six positions relative to the teeth on the single-drive ratchet—each position being equal to one indexing of the single-drive ratchet. These positions are No. 1, 2, 3, 4, 5, and S (space) (see fig. 26). When the double-drive ratchet tooth is in the No. 5 position, the double-drive ratchet pawl will engage the tooth and step the ratchet from the No. 5 position through the (space) position (S) to the No. 1 position.
  4. The object of all mechanical action initiated when the selector handle is moved from P to the E position is to prearrange the tape feed mechanism so that spacing is initiated on the first character of a five-letter group. This is accomplished when the double-drive ratchet is in the No. 1 position on the first key operation in E position.
  5. When the stop pawl was disengaged from the stop and double-drive ratchets and the compression spring expanded, the double-drive ratchet was automatically moved from the No. 4 position to the S position (see fig. 26-B).
- (b) When the automatic cycling of the machine occurs, the following action takes place (see fig. 26-C):
1. The tape ribbon drive shaft eccentric initiates the action of the single-drive and double-drive ratchets. The single-drive ratchet pawl indexes the single-drive ratchet one tooth. The ratchet, turning on the squared portion of the tape feed roll drive shaft, turns the feed roll and advances the paper tape one space. The double-drive ratchet moves but is mechanically ineffective because it is in the S position.
  2. Since the stop ratchet is no longer engaged by the stop pawl, the detent pawl indexes the stop ratchet through the detent ratchet. This movement tends to contract the compression spring between stop and double-drive ratchets for a distance which is comparable to one single-drive ratchet tooth. As the spring expands with the rotation of the stop ratchet, the double-drive ratchet is also indexed one space.
  3. When the double-drive ratchet is indexed, the small diameter tooth moves from S position to position No. 1 with respect to the double-drive ratchet (see fig. 26-C). After five more machine operations, the pawl will be permitted to engage with the ratchet tooth.
  4. Since the double-drive ratchet tooth was mechanically set up in position No. 1 by the movement of the selector handle from P to E position, initiation of five-letter groupings on the initial character is assured.
- (c) During the next four machine operations the single-drive ratchet pawl continues to index the single-ratchet (see fig. 26-C through 26-F). The paper tape is advanced one space and the stop and double-drive ratchets are indexed in a manner similar to that described in subparagraph b above. On the fifth operation (see fig. 26-G), however, the double-drive ratchet pawl engages a tooth on its downward travel. As it travels upward, the following action occurs:
1. The double-drive ratchet and stop ratchet are indexed the equivalent distance of two single-drive ratchet teeth.
  2. The detent ratchet engages the detent on the single-drive ratchet and rotates the single-drive ratchet two teeth.
  3. The single-drive ratchet, turning on the squared portion of the tape feed roll drive shaft, turns the tape feed roll and advances the paper tape two spaces.
  4. The double-drive ratchet is moved past the S position into position No. 1.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

- (8) *P through E to D Position.*—When the selector handle is moved from the P position through E to D position, the following action takes place:
- As the selector handle passes through the E position, the tape feed mechanism reacts in its normal manner. That is, the stop pawl disengages from the double-drive and stop pawl ratchets thereby permitting the compression spring to advance the double-drive pawl two spaces. The machine automatically cycles and advances all ratchets another space.
  - As the selector handle is moved beyond the E position, the sliding contact board cam is disengaged from the follower so that the bracket plunger and bracket lever return to their normal positions.
  - After four machine operations with the selector handle in D position, the double-drive ratchet will be engaged by the stop pawl. After two more operations, the stop pawl will engage the stop ratchet. This mechanical action has no effect on spacing the tape.
- e. *Gear Housing (fig. 29).*—The gears for all major components of the printer unit mesh in the gear housing assembly. By interrelating the gears in various ratios, correct operating speeds for individual components are obtained. Individual gears may be described as follows:
- The Motor-Generator gear.*—This gear is driven by the motor-generator and operates at approximately 6600 rpm. The rotation of this gear is continuous so long as the motor-generator is operating.
  - Helical Gear and pinion assembly.*
    - The motor-generator gear meshes with the helical gear of the pulse generator gear with a reduction ratio of 3 to 1. Thus, the helical gear, which drives the pulse-generator rotor shaft and figured wheel, operates at approximately 2200 rpm.
    - The pinion gear is part of the same assembly as the helical gear and also operates at approximately 2200 rpm.
  - Clutch drive assembly helical gear.*
    - The pinion gear meshes with the helical gear of the timing unit clutch drive assembly. Since the pinion gear is part of the helical gear and pinion assembly, it links the clutch drive assembly helical gear to the motor gear. The reduction ratio from the motor-generator gear through the pinion to the clutch drive assembly helical gear is 11 to 1. Thus, the helical gear operates at approximately 600 rpm.
    - The clutch drive assembly helical gear initiates the drive for most of the mechanical functions of the machine. Since there are no further gear reductions, all dependent mechanical operations are driven at 600 rpm.
  - Timing shaft.*—The helical gear rotates the timing shaft at 600 rpm when the shaft is engaged with the clutch drive assembly. The timing shaft miter gear and the coupling key are mounted on one end of the timing shaft. Rotation of the timing shaft affects these components as follows:
    - The timing shaft miter gear meshes with the crankshaft miter gear and operates the rotor stepping drive link assembly. Since the ratio between the two miter gears is 1 to 1, the crankshaft miter gear operates at approximately 600 rpm when the timing shaft clutch is engaged.
    - The coupling key couples the tape and ribbon ~~and ribbon~~ drive shaft to the timing unit drive shaft. The tape and ribbon drive shaft, therefore, also operates at approximately 600 rpm when the timing shaft clutch is engaged.
- f. *Crankshaft and Drive Link Assemblies (fig. 29).*—The purpose of these assemblies is to transfer mechanical power from the timing shaft to the rotor stepping unit.
- The physical description of the individual components is as follows:

~~CONFIDENTIAL~~

ORIGINAL



~~CONFIDENTIAL~~

KAM-1/TSEC

- (a) The crankshaft miter gear is mounted on one end of the crankshaft and meshes with the timing unit miter gear.
  - (b) A crank pin is mounted on the opposite end of the crankshaft. It is offset from the axis of the crankshaft so as to provide an eccentric motion. When in its resting position, the crank-pin is in its most forward position.
  - (c) The ball-bearing end of the drive link assembly is mounted over the crankpin. At the other end of the assembly a yoke engages with the rotor stepping crankpin. This yoke is held against the crankpin by means of a spring.
- (2) *Operation of assemblies.*—The crankshaft miter gear turns the crankshaft and the crankpin counterclockwise (when viewed from the right side of the printer unit). Because the crankpin is offset from the axis of the crankshaft, the rotating motion of the crankshaft is converted into a linear movement and the drive link assembly moves backward and forward. This, in turn, moves the rotor stepping crankpin back and forth.
- g. *Timing Unit.*—The timing unit initiates the mechanical action for rotor stepping, spacing of the paper tape and inked ribbon, and makes and breaks electrical circuits by means of its four associated cam switches. The timing unit is so designed that each action which it originates is synchronized for correct machine operation.
- (1) *Housing assembly (fig. 23).*—The individual components of the timing unit are contained in the housing assembly. It provides position and support for the detent pawl eccentric stud, which adjusts the position of the detent pawl. The housing unit also provides the plugs and inserts for the trip magnet assembly adjusting screws which adjust the position of the trip magnet. Tracks machined in the housing provide a means to mount the trip magnet. The timing shaft rear bearing and the clutch drive bearing are press fitted into the housing.
  - (2) *Clutch drive assembly (fig. 23).*—Motor torque to operate the timing unit is provided through the clutch drive assembly. This unit is a bell-shaped hub in which the helical gear drives a ratchet which is machined on the raised hub end. The timing shaft rides in the axis of the unit and is provided with a sealed bearing, felt seal, and an oil ring to overcome friction. When the timing unit clutch engages the ratchet, the timing shaft will rotate. Since the helical gear rotates at 600 rpm, the timing shaft will also rotate at 600 rpm.
  - (3) *Timing shaft and associated parts (fig. 24).*—The timing shaft contains all of the elements necessary to initiate specific actions of the timing unit. All members of the shaft are keyed so that the correct positioning is insured during reassembly.
    - (a) *Clutch pawl.*—The clutch pawl is hinged on the clutch pawl carrier which, in turn, is keyed to the timing unit shaft. When the trip magnet is not energized, its armature engages the clutch pawl stop which prevents the clutch pawl tooth from engaging the clutch drive ratchet. When the stop is disengaged by the trip magnet armature, the spring-tensioned pawl tooth engages the clutch drive ratchet. The engagement of the clutch pawl tooth with the clutch drive ratchet, which is continuously rotating at 600 rpm, completes the mechanical linkage necessary to rotate the timing shaft. After one cycle of the timing shaft, the trip magnet armature will again engage the clutch pawl stop and the clutch pawl tooth will be disengaged from the ratchet, breaking the mechanical linkage.
    - (b) *Timing shaft coupling key (fig. 23).*—The tape ribbon drive shaft is keyed to the timing shaft through the timing shaft coupling key. This means of coupling insures that the tape eccentric (see subpar. 4006d(1)) is in its correct position relative to the position of the timing shaft.
    - (c) *Timing shaft miter gear.*—See subparagraph 4006e(4)(a) for a detailed discussion of this gear.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

- (d) Cam operated switches and associated parts.—Electrical circuits within the cipher machine are determined by four single-pole, double-throw, break-before-make, cam-operated switches.
1. A four-section moulded plastic cam is keyed to the timing shaft. Each section of the cam governs the action of a single switch.
  2. With the timing shaft in its stop position, all lower switch contacts are closed (see fig. 24-B). After 10 degrees rotation of the timing shaft, the cam causes the lower switch contacts to open, and the upper contacts to close.
  3. Correct adjustments of the cam-operated switches is imperative to correct machine operation. Malfunctions of the switches can cause troubles which would seem to be completely divorced from the timing unit. Damping leaves prevent "bouncing" of the swingers against the cam. Mechanical adjustments for the cam-operated switches are outlined in paragraph 6305. Beginning with the cam and switch nearest the rear of the housing assembly, the functions of the switches (numbered as in fig. 24) are described in subparagraphs 4 through 7 which follow.
  4. The charge cam switch (#1).—The upper contacts of the cam switch are closed from 10 to 350 degrees of rotation of the timing shaft. The charge cam switch has two functions. First, it prevents the print tube from firing more than once for a single key operation. Secondly, it permits the print capacitors, C101 and C107, to recharge in sufficient time for the next machine operation.
  5. Repeat cam switch (#2).—The upper contacts of the repeat cam switch are closed from 10 to 330 degrees of rotation of the timing shaft. The repeat cam switch serves as an electrical interlock to prevent possible double cycling, especially when the cipher unit is in operation.
  6. Figure cam switch (#3).—The upper contacts of the figure cam switch are closed from 10 to 70 degrees of rotation of the timing shaft. This switch is utilized only in the E and D positions. It makes possible the enciphering and deciphering of a figure function without disturbing the rotor stepping pattern.
  7. Letters cam switch (#4).—The upper contacts of the letters cam switch are closed from 10 to 60 degrees of rotation of the timing shaft. This switch also is utilized only in the E and D positions. It makes possible the enciphering and deciphering of a letter function without disturbing stepping pattern.
- (4) *Trip Magnet Assembly*.—When energized, the trip magnet permits the clutch drive pawl to engage the clutch drive ratchet. The trip magnet is energized electronically. The armature of the trip magnet is not fastened to the magnet coil assembly, but is a separate part, held in place by a spring. Adjusting screws provide a means to position the trip magnet relative to the clutch pawl stop. The housing assembly provides the tracks necessary to mount the trip magnet.
- (5) *Detent Pawl*.—The purpose of the detent pawl is to prevent the clutch pawl tooth from dragging on the clutch drive ratchet when it is not engaged. It accomplishes this by engaging a notch on the clutch pawl carrier and thus secures the position of the clutch pawl tooth against its spring tension. An eccentric (see fig. 24-A) provides for adjusting the effective length of the detent pawl (see par. 6311).

#### 4007. Rotor Stepping Unit (fig. 30).

- a. *General*.—The purpose of the rotor stepping unit is to step rotors in a confused but predetermined pattern in the E and D positions, and to provide a means of aligning the rotors to the correct cryptographic key in P position. A secondary function of the unit is to indicate the number of machine operations, which it does by means of a mechanical counter unit. Individual components are as follows:

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (1) *Rotor stepping frame.*—All operating components are housed or mounted on the rotor stepping frame. In addition to this function, the frame provides a means of securing the rotor stepping unit to the contact panel. This is accomplished by two slotted mounting blocks at the rear corners, and two special screws, at the front corners.
- (2) *Rotor stepping drive shaft.*—The purpose of this shaft is to apply the mechanical pressure necessary to the individual drive linkage assemblies to step their respective rotors. Operational features are as follows:
  - (a) The rotor stepping drive shaft has seven ball-bearing, roller-type cams; one for each drive linkage assembly. The rotor stepping drive shaft crankpin is fastened to the squared end of the drive shaft and fits into the rotor stepping drive link yoke.
  - (b) When the machine cycles, the drive link assembly moves, first backward, then forward. On the backward movement, the roller cams move away from the drive linkage assemblies. If a stepping magnet has been energized, the backward movement will permit a spring to impart motion to that particular drive linkage. On the forward motion, the roller cam will bear against the drive linkage with sufficient force to step the associated rotor one position. No motion is imparted to the rotors unless the associated stepping magnet is energized.
  - (c) Between the third and the fourth cams from the left, there is a projecting arm to which the counter link is attached. This link advances the mechanical counter one step for each complete movement of the rotor stepping drive shaft, thereby indicating the number of machine operations.
- (3) *Drive linkage assembly and associated parts.*
  - (a) The purpose of the drive linkage assemblies is to step rotors when they should be stepped and to hold rotors stationary when they should not be stepped.
  - (b) The complete assembly consists of seven individual drive linkage assemblies mounted on the drive linkage assembly shaft. The shaft is secured to each side of the rotor stepping unit frame. Two collars secure the position of the seven drive linkage assemblies with respect to their respective rotors.
  - (c) The positioning arm, which is located between the third and the fifth drive linkage assemblies, serves as a spacer and holds the fourth rotor stationary when the cipher unit shell is removed. (The No. 4 rotor is to remain stationary at all times. It, therefore, has no drive linkage assembly.) Correct tension for the positioning arm is provided via a compression spring which is imbedded in the rotor stepping frame. A setscrew (see adjustment par. 6203) governs the amount of tension for the compression spring.
  - (d) Each of the seven drive linkage assemblies consists of the following basic components:
    1. *Drive linkage carrier.*—The drive linkage carrier assembly is the main element of the drive linkage assembly. A hard-tempered, flat surface which is brazed to the back of the carrier provides a contact surface for the rotor drive shaft roller bearing cams. A bushing in the top end serves as a mounting hole for the drive linkage carrier shaft. The boot-shaped lower end of the carrier engages with the rotor stepping magnet armature to block any backward movement. The hold-down spring tensions the carrier so that it pivots backward when the rotor stepping magnet is energized.
    2. *Drive pawl.*—The drive pawl section of the drive linkage assembly fits into a notch in the rotor alphabet ring and moves the rotor one step when activated by the drive linkage assembly. The drive pawl is attached to the carrier drive linkage assembly by means of an eccentric pin which adjusts the effective length of the drive pawl so that it steps the rotor correctly.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

3. **Stop pawl.**—The purpose of the stop pawl is to hold the rotor stationary when it is not being stepped. Two compression springs, located between the drive linkage carrier and the stop pawl, hold the stop pawl against the rotor. When the drive linkage carrier pivots backward, the stop pawl moves with it. When the drive linkage carrier pivots forward, the stop pawl fits into a notch in the rotor. The compression spring then exerts its pressure and the stop pawl resists further movement of the rotor.
4. **Hold-down spring.**—The hold-down spring moves the drive linkage assembly backward when the rotor stepping magnet armature is tripped. One end of the hold-down spring is fastened to a stud which is set into the stepping unit frame. The other end is secured to a spring post on the drive linkage carrier.
- (5) **Rotor stepping magnet assemblies.**—There are seven rotor stepping magnet assemblies, one for each of the movable rotors. The armatures are held away from the magnet by two flat springs which are part of the magnet assembly. The rotor stepping frame contains eight slotted holes through which two mounting screws secure each magnet assembly against the frame. (Slots rather than individual holes are used so as to permit positioning the rotor stepping magnet assemblies with respect to the drive linkage carriers. Each magnet armature acts as a stop for its associated drive linkage.)
- (6) **Actuator switch assembly and associated parts.**—The actuator switch assembly is composed of a switch plate, five seven-leaf switches, and two six-leaf switches. This assembly, together with the actuator spring and clamping plate, is fastened to the under side of the frame. Each switch is composed of two sections, the operating leaves of which are independent of each other. The two types of switches are as follows:
- (a) **Seven-leaf switches.**—These switches are located beneath the first, second, third, sixth, and seventh rotors. The upper sections are a single-break before single-make arrangement and consist of the switch leaves numbered 3, 6, and 7, of which leaf No. 6 is the swinger. The lower sections are single-break before double-make arrangements consisting of the leaves numbered 1, 2, 4, and 5, of which leaf No. 2 is the swinger.
- (b) **Six-leaf switches.**—These switches are located beneath the fifth and eighth rotors. The upper sections, which are single-break no-make arrangements, consist of leaves numbered 6 and 7. Leaf No. 6 is the swinger for this section of the switch assembly. The lower sections, which are single-break before double-make arrangements, consist of leaves numbered 1, 2, 4, and 5, of which leaf No. 2 is the swinger.
- Note:* The No. 4 rotor is stationary and therefore requires no actuator switch.
- (7) **Set key assembly (fig. 30-A).**—Set keys operate the bottom sections of the actuator switches by means of spring-loaded plastic plungers which move through sleeves. When a set key is depressed, the plunger moves the swinger (No. 2) from the No. 5 leaf and holds it against leaves No. 1 and 4. The seven set keys are mounted on two shafts and are secured to a single plate. The complete assembly is removable as a unit. The individual plungers, springs, and sleeves may also be removed.
- (8) **Actuator switch assembly (fig. 30-A).**—The upper sections of the actuator switches are operated by the lobes on the notched rings of the rotor assemblies, acting through actuator assemblies in the stepping unit. When depressed by a lobe on the rotor notch ring, the actuator moves the swinger (No. 6 leaf) away from the No. 7 leaf. In the seven-leaf switches, this action also brings the No. 6 leaf into contact with leaf No. 3, to the correct position relative to the No. 3 leaf of the actuator switch assembly.
- (9) **Bottom cover.**—The bottom cover protects the rotor stepping unit from dust and foreign matter when it is removed from the cipher machine.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

- (10) *Counter unit.*—The counter unit is a standard four-digit mechanical counter. It is connected to the rotor stepping drive shaft by means of the counter link, counter block, and counter spring. The counter records one digit for each oscillation of the rotor stepping drive shaft. The counter spring permits overtravel of the connecting link without injuring the internal stops of the counter.
  - (11) *Contact block assemblies.*—The rotor stepping frame also houses three blocks which contain flat-head type contacts. The flat-head contacts in the four-contact block mate with the four pressure contacts of the contact panel which carry the electrical input for the rotor stepping unit. The remaining two blocks, each of which contains 10 flat-head contacts, are located one on each side of the frame. Their contacts mate with pressure contacts in the cipher unit and establish the reentry circuits.
  - (12) *Right and left-hand latch assemblies.*—The purpose of these latches is to hold the cipher unit in position on the rotor stepping unit. A downward pressure must be exerted on the cipher unit before the latches will catch and lock securely.
- b. *Mechanical Function in P Position.*—Each of the seven rotors is set to its initial rotor operating position while the machine is in the P position. This is accomplished by depressing the set key in front of the rotor to be stepped. The depression of this set key results in the following action.
- (1) Depression of the set key forces a spring-loaded plunger against the lower actuating leaf of its corresponding actuator switch. This closes two circuits. The first to close is the one which energizes the corresponding stepping magnet. The second to close is the one which energizes the trip magnet of the printer. The energizing of the stepping magnet draws its armature out of the path of the drive linkage assembly. This allows the drive linkage assembly to pass over the armature. The energizing of the trip magnet results in cycling of the cipher machine. The lateral motion of the drive link assembly oscillates the rotor stepping drive shaft through an arc of 75 degrees.
  - (2) With the cipher machine in a rest position, the rotor stepping drive shaft is in its full forward position and its seven roller-bearing cams hold the seven drive linkages in their full forward position (fig. 30).
  - (3) As a cam of the rotor stepping drive shaft starts moving backward, the energized stepping magnet allows the drive linkage carrier to be drawn back toward its cocked position by the hold-down spring.
  - (4) The entire drive linkage pivots on the drive linkage shaft and within itself at the eccentric pin. This compound motion of the drive linkage allows the stop to be pulled free of the notch in the alphabet ring and the drive pawl to be disengaged from its notch.
  - (5) During the backward travel of the drive linkage, the point of the drive pawl bears against the periphery of the alphabet ring until it reaches a point where it engages the next notch. This is accomplished by the drive pawl being pivoted about the eccentric pin by the drive pawl spring.
  - (6) At 180 degrees of the timing shaft rotation, the rotor stepping drive shaft reaches the end of its 75-degree arc. Its direction is now reversed and the roller cam starts moving forward. The cam bears against the rear edge of the drive linkage and forces it forward.
  - (7) The forward point of the drive pawl, which is engaged in a notch of the alphabet ring, turns the rotor about its shaft through an arc of 10 degrees.
  - (8) Just before the drive linkage reaches its full forward position the spring-loaded stop swings up and comes into contact with the alphabet ring periphery. The stop bears against the periphery until, at the end of the stepping stroke, a notch in the periphery becomes aligned with it. The stop then drops into the notch and the rotor is locked in this position.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (9) Release of the set key prior to the time that the drive linkage assembly reaches its full forward position allows the switch leaves of the lower section of the actuator switch to separate. This breaks the circuits which are energizing the stepping magnet and the trip magnet.
  - (10) Providing that the set key has been released, the spring-loaded armature of the stepping magnet is allowed to rise toward its stop position. As the drive linkage carrier passes over it, it depresses the armature. As the trailing edge clears the armature, it rises and engages the notch on the trailing edge of the drive linkage carrier.
  - (11) The stepping magnet armature acts as a stop for its corresponding drive linkage assembly. For each oscillation of the rotor stepping drive shaft only those drive linkages whose corresponding stepping magnets are energized are pulled back to a cocked position.
  - (12) Holding the set key depressed keeps the stepping magnet and the trip magnet energized and steps the associated rotor one position for each cycle of the cipher machine.
- c. *Mechanical Function in E and D Position.*—During encipher and decipher operation, the upper sections of the actuator switches are utilized to control the energizing of the seven stepping magnets. The actuators in turn are controlled by the notch rings of the rotors.
- (1) Rotation of the rotors during the stepping phase also rotates the notch rings. When a lobe on the notch ring contacts an actuator, the actuator is forced down. This results in the changing of the upper section of the actuator switch circuits through the medium of the active leaf.
  - (2) The actuator switches are all interwired and connected to the stepping magnets. Due to the combination of connections made by these switches, certain stepping magnets are energized.
  - (3) For each cycle of the machine during encipher and decipher operation, those stepping magnets which are energized allow their associated rotors to be stepped in the same manner as described in subparagraph b above.
- d. *Counter Operation.*—The mechanical operations counter, which is mounted on the front of the rotor stepping unit, is actuated once for each oscillation of the rotor stepping drive shafts. The counter spring absorbs overtravel in excess of the counter's normal motion, thus minimizing strain on the internal counter parts.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

**4008. KLX-7/TSEC Keyboard Adapter (fig. 66).**

- a. The KLX-7/TSEC keyboard adapter permits the cipher machine to be operated by means of a standard teletypewriter tape. When correctly inserted into the cipher machine, the keyboard adapter transfers the output of the TSEC/HL-1 to selected key circuits in the TSEC/KL-7.
- b. The KLX-7/TSEC is a phenolic fiber board assembly into which are set 30 pressure contacts with caps extending through the upper part of the assembly. Two other contacts on the right hand side of the adapter connect the power input leads to the machine. Other important physical features include an extension for the selector handle and five screws by which means the adapter can be mounted between the keyboard and the sliding contact board. Also, a receptacle and wiring is provided for electrical connection within the unit.
- c. The layout of the contacts on the keyboard adapter duplicates the keyboard itself and key switches can be closed through the capped extensions and pressure contacts to the sliding contact board so that printing is initiated in the normal manner.
- d. The TSEC/HL-1 (an ancillary tape reader) senses a five level teletypewriter tape and interprets the signals through a series of relays as a literal signal. One side of the sensing mechanism is electrically tied to common in the TSEC/KL-7 through the keyboard adapter pin A7. Circuits are completed from common in the TSEC/KL-7 through the sensing pins and relays in the tape reader to specific points on the output plug of the TSEC/HL-1. The points on the output plug are wired through a cable and the keyboard adapter to individual key circuits in the TSEC/KL-7. Circuits completed to these individual key circuits effectively simulate a key closure and printing is initiated in the normal manner.
- e. Twenty-four volts DC are supplied from the TSEC/KL-7 to the "Set-on-Blank" relay in P, E, or D operation and to the "Letters Reject Circuit" in D operation. This connection is made from pin A1 in the keyboard adapter through the adapter cable. The detailed function of these relays is discussed in AFSAG 1207B.
- f. The AC input for the TSEC/HL-1 is provided via a special plug and cable which ties into the large plug on the adapter cable.

**4009. Motor-Generator and Controller Assembly (fig. 57-B).**

- a. The CE 88000 motor-generator and controller assembly replaces the CE 87420 motor-generator and controller assembly on TSEC/KL-7 with Serial No. 13149 and all subsequent equipments.
- b. The CE 88000 motor-generator and controller uses a governor in series with its field to maintain a constant speed over the full range of operating voltages (21- to 31-volts DC). With the old style motor-generator, key closure would sometimes cause the motor to drag when the equipment was operating in the lower regions of its voltage range. Such action resulted in printing smudge, character shift, and production of fly characters.
- c. Like the old-style motor-generator, the CE 88000 motor is a shunt wound DC motor which operates on the following basic concepts.
  - (1) The field interacts with the armature to generate a cemf in the armature.
  - (2) The more cemf generated, the slower the motor will rotate and, conversely, the less cemf, the faster the motor will rotate.
  - (3) The cemf generated is proportional to the current in the field and it is inversely proportional to the resistance of the field.
- d. When the motor is at rest, the contacts on the centrifical governor are open effectively inserting a 100 ohm resistor (CE 88036) in series with the field. The increased resistance, lowers the current and the resultant cemf, causing the motor to speed up.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- f. When the motor reaches a sufficient speed, centrifical force closes the governor contacts, shorting the 100 ohm resistor. The decreased resistance raises the current and resultant cemf, causing the motor to slow down.
- g. The 680 micromicrofarad capacitor (CE 88037) is a spark suppressor for the governor contacts and the 31 ohm resistor (CE 88040) is a current limiter to prevent excessive current surges when the contacts close.

**4010. ~~GE 88066~~ AC Power Converter.**—There are currently two versions of the AC power converter being used for the TSEC/KL-7. The older one, ~~Part No. CE 87066~~, is designed to produce 2.4 amperes output current. The newer one, ~~Part No. CE 88066~~, will produce 4.5 amperes of current. Otherwise both units are identical and may be used interchangeably with any TSEC/KL-7. The higher current output of the ~~CE 88066~~ converter, however, may prove more efficient when operating under the increased current drain of the governor contacts on the CE 88000 motor-generator. Also, it is more adequate to the inherent resistance in selenium rectifiers which is caused by aging. Units above Serial No. 15412 are the ~~CE 88066~~ power converter.

**4011. CE 87422 Radio Interference Filter (fig. 57-A).**

- a. The radio interference filter has been added to suppress line current variations due to the TSEC/KL-7, which may cause interference with the operation of nearby radio equipment. Variations in the line current are caused chiefly by the motor-generator and the rotor stepping unit. The filter effectively eliminates the problems concerned with variations in line current.
- b. Each side of the DC input line is tied to ground through a separate pi-type configuration in the filter assembly. The net result is effective attenuation of fluxuations in line current over a wide band of frequencies. The following chart illustrates the efficiency:

Frequency in MC	Attenuation in DB
0.1	47
0.3	76
0.7	91
2.0	95
5.0	90
10.0	87
30.0	80
70.0	64

- c. No maintenance should be performed in direct connection with the filter except replacement of the item as a complete unit or repairing its external connections.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

## 4100—ELECTRONIC THEORY

**4101. General.**—The electronic and electrical circuits of TSEC/KL-7 may be described generally as follows:

- a. *Key Circuits.*—These circuits are completed manually at the keyboard and perform the following basic functions:
  - (1) They initiate a pulse of the proper magnitude to actuate the electronic circuits. Since the cipher unit is part of the key circuits in the E and D functions, this pulse may be either the plain, enciphered, or deciphered version of a given letter or figure.
  - (2) In association with the sliding contact board and guide-rail assembly, which serves as a four-position, multicircuit switching device, the key circuits also control the electronic circuits so that the letter shift, figure shift, spacing, and repeat operation functions are performed.
- b. *Tube Circuits.*—Once a character pulse is initiated by the key circuits, the electronic circuits initiate the action which results in printing the correct letter on the paper tape.
- c. *Power Circuits.*—These circuits provide the power to perform the electrical and mechanical functions of the machine. The power circuits may be divided into three basic circuits as follows:
  - (1) *Low voltage supply.*—This supply is provided from an external source of DC and operates tube filaments, the motor, and rotor stepping magnets.
  - (2) *High voltage supply.*—The output from a 400-cycle AC generator (driven by the motor) is rectified by a full-wave bridge rectifier composed of germanium diodes. This provides the high DC voltage required by the electronic circuits.
  - (3) *Key circuit supply.*—Power for the key circuits is supplied by a pulse generator as described in subparagraph 4006b(1).
- d. *Rotor Stepping Magnet Circuits.*—The necessary power to energize the selected rotor stepping magnet is provided by the low voltage power source as explained in subparagraph c above. Which rotor stepping magnets are to be selected is determined by the actuator switches. These switches, operated mechanically by rotor notch rings in E and D positions complete circuits through the rotor magnets causing the magnets to step the rotors in a confused but definite pattern. In P position, the rotor stepping magnets are energized by manually operated set keys.

**4102. Sliding Contact Board and Guide Rail Assembly** (see par. 4004).—This contact board serves as a four-position, multicircuit switching device. By moving the selector handle to any of four positions, the board automatically completes circuits which achieve the functions designated by the pointer on the selector handle. Specifically, the sliding contact board and guide-rail assembly accomplishes the following:

- a. *O Position* (fig. 14-A).—This is the OFF position for the machine. As shown, the double T contacts which connect the external DC power to the cipher machine are completely withdrawn from the K1 contact (on the contact panel board) and the spring contacts above the sliding board.
- b. *P, E, and D Positions.*—In these positions the following occurs:
  - (1) In P, E, or D position, the DC power input circuit is completed through the double T contacts from the power switch leaves to input contacts K1 and K2 (K2 contact not shown in fig. 14-A). Thus, power is supplied to the machine for each of its three functions.
  - (2) In positions E and D, circuits are set up which permit the enciphering and deciphering of figures and letters functions through the figure and letter cam switches.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (3) Positive return leads of the rotor stepping magnet circuit are switched so that the set keys energize the stepping magnets in the P position, while the rotor notch rings energize them in E and D positions.
- (4) When the sliding contact board is moved from P to O position, the plate circuit of the print tube is opened. This prevents misfires caused by the bias voltage on the grids dropping to zero more rapidly than the plate voltage when the power is cut off (see subpar. 4110e).
- (5) A means to step rotors automatically is provided by the switching completed in the contact panel when the selector handle is moved from P to E position (see subpar. 4110d). Circuits are set up by the sliding contact board which cause the rotors to be stepped immediately.

**4103. Key Circuit, P Operation (fig. 16-A).**—In P operation depression of any one of the keys (excepting the FIG, LET, and RPT keys), or the space bar, completes a circuit through a character pulse coil and the primary winding of the transformer. The amplitude of the pulse is stepped up by the transformer and applied to the electronic circuits which initiate the action required to print. When any of the 10 alpha-numeric keys (Q-1, W-2, E-3, R-4, T-5, Y-6, U-7, I-8, O-9, or P-0) is depressed, the character printed will be either the letter or figure represented on the key, depending on the function indicated by the neon glow lamp. Using the K key for purposes of illustration, the circuit operates as follows:

- a. In P position, the sliding contact board is positioned so that all keys mate with the center of T-shaped contacts, and the T-shaped contacts in turn mate with pressure (P) contacts representing individual keys. Thus, the T-shaped contacts close the circuit between the K key and the KP contact.
- b. One side of all key switches are connected to common, and one side of all coils in the pulse generator are connected to the plus 220-volt supply line. Depression of the K key, therefore, connects the free end of the pulse generator K coil to common. Since the pulse generator coils have a very low DC resistance, closing the K key effectively connects the plus 220-volt line to common, with the result that there is a large voltage drop across the K coil. This voltage drop generates a considerable amount of cemf across the K coil in such a manner as to oppose current flow between common and plus 220v. This cemf, together with the heavy voltage drop, actually makes the end of the K coil that is connected to the 220-volt supply line negative with respect to common.
- c. This action generates what is known as the transient pulse. This pulse is of such polarity as to actuate the electronic circuits just as any normal character pulse. The only difference is that the normal pulse represents a definite character on the figured wheel whereas the transient does not. For more details concerning the effects of the transient pulse, see paragraph 4108 and 4109. Circuit elements are employed to prevent the transient pulse from initiating the printing action.
- d. When the rotor of the pulse generator passes the K pulse coil, the voltage induced in the pulse coil causes current to flow through the closed key circuit and a voltage to be induced in the secondary winding of the transformer.
- e. The direction of current flow as initially induced by the pulse generator rotor is such that the current passes through diodes D115, D101, and D102 to the primary winding of the transformer. After the rotor passes the K coil, the decaying magnetic flux tends to induce a current flow in the opposite direction. Now, however, the diodes which pass current in only one direction prevent the current from entering the primary of the transformer. This prevents spurious pulses from entering the electronic circuits.
- f. The pulse on the primary winding of the transformer initiates instantaneous electronic action. At the instant action is initiated, however, the K character on the figured wheel is not yet in

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

the print position because allowance must be made for the mechanical delay time required for the print hammer to strike against the paper tape. Approximately 2~~5~~<sup>10</sup> milliseconds must be allowed for the print hammer to reach the tape and inked ribbon after the print magnet is energized. When the desired character is not in the correct position when the print tube fires, broken or incomplete characters are printed on the tape.

- g. The pulse delivered by the K coil to the primary of the transformer has an amplitude of ~~5~~<sup>10</sup> volts, and is negative with respect to common. Had an alpha-numeric key been depressed, two pulses would have been delivered to the primary of the transformer. As explained in subparagraph 4006b(2)(b), the pulse representing the alpha (letter) function has an amplitude of 5 volts, while the pulse representing the figure function has an amplitude of 10 volts.

**4104. Key Circuit, E Operation (fig. 16-B).**—In E position, the cipher unit is switched into the key circuit. Depression of any key (including the FIG and LET keys), or the space bar completes a circuit through the cipher unit and causes the enciphered version of the character or function to be printed on the tape.

*Note:* Some of the key circuits are combined in E operation so that letter and figure functions can be enciphered. These circuits are termed special key circuits in paragraph 4106.

Discussion of a normal key circuit (K, for example) follows:

- a. In the E position, the sliding contact board is positioned so that the key contacts connect through T-shaped contacts to the E pressure contacts representing individual keys. The K key, is thus connected to pressure contact KE. Also in the E position, connecting bars connect D pressure contacts to P pressure contacts. Thus, KD is connected to KP, GD is connected to GP, etc.
- b. Depression of the K key now closes the circuit to the KE pressure contact, which is wired directly to terminal EK on the encipher (left) side of the cipher unit.
- c. The circuit then passes through the seven movable and one stationary rotor of the cipher unit and terminates on any one of 26 D terminals on the decipher side of the cipher unit, or on one of the 10 reentry circuits.
- d. If the circuit terminates on one of the reentry circuits, it is rerouted back to the encipher side of the cipher unit through a direct wire connection and again passes through the rotors with the option of terminating at any one of the 26 D terminals or the nine remaining reentry circuits. This process can continue until all 10 reentry circuits have been utilized, thus making it possible to route a single circuit through the cipher unit 11 different times (or through 88 rotors) before finally terminating the circuit on one of the 26 D contacts on the decipher side of the unit.
- e. Assuming that the rotors are set up so that the K key circuit passes through the cipher unit directly to the DG pressure contact, the circuit continues through a direct wire to the GD pressure contact in the keyboard area, where it is connected to GP through the connecting bar. From here the circuit is similar to that described for any normal key circuit in P operation—the only difference being that the letter printed (G) represents the enciphered version of the depressed K key.

**4105. Key Circuit, D Operation (fig. 16-C).**—In D position, the cipher unit remains in the key circuit but the path through it is reversed from that in encipher. In E operation the circuit entered the unit from the left side; in D operation, however, the circuit enters from the right side of the unit. Depression of any key representing the enciphered version of a character or function results in printing the decipher version on the paper tape.

*Note:* As was the case in E operation, special circuits must be employed in D operation to utilize letters, figures, and space functions. A detailed discussion of these circuits appears in paragraph 4106. Again assuming G to be the enciphered version of the letter K, discussion of a normal key circuit follows:

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- a. In D position, the sliding contact board is positioned so that the key contacts are connected to the D pressure contacts. Thus, the G key connects to the GD pressure contact. Also in D position, connecting bars are used to connect E pressure contacts to P pressure contacts, so that GE is connected to GP, KE is connected to KP, etc.
- b. Depression of the G key now closes the circuit to the GD contact, which is wired directly to terminal DG on the decipher (right) side of the cipher unit.
- c. The stepping pattern maintains exactly the same circuit through the rotors whether operating in E or D position, only the direction of current flow is reversed. The circuit from DG is completed through the cipher unit to the terminal on the encipher side where it originated during E operation. In this example the circuit is routed from DG through the rotors and reentry circuits to terminal EK. Terminal EK is wired to KE in the keyboard and KE is connected to KP by the connecting bar. From this point the circuit is similar to that described for any normal key circuit, except that the letter printed represents the deciphered version of the depressed key.

**4106. Special Key Circuits.**—Special key circuits are required to encipher and decipher figures, letters, and spacing functions.

*Note:* The RPT key also initiates a special function, that of permitting any other key circuit to print continuously in its plain text, enciphered, or deciphered versions (see fig. 14-D). The circuit action of the RPT key is discussed in greater detail in subparagraph 4110f.

- a. *Figure, J, and Y Key Circuits (fig. 18).*—These circuits are used to accomplish the figures function in both encipher and decipher operation. In P operation, the J and Y keys operate as normal keys and produce their normal J and Y representations on the paper tape. Depression of the FIG key in P operation sets up the circuitry required for figures to be printed when alpha-numeric keys are depressed. The figure key circuit accomplishes its function with out printing or cycling the machine.
  - (1) In E operation, the enciphered versions of figures appear on the tape as letters. This is a cryptographic feature of TSEC/KL-7 which is used for security rather than mechanical reasons. Operation for this function is indicated by the neon glow lamp. When the neon lamp glows, depression of an alpha-numeric key results in the enciphering of the figure associated with that key.
  - (2) Because everything in an enciphered message appears as letters, the operator has no visual indication at which point the figures function is to be effected in D operation. It is necessary, therefore, to provide some means to switch the figures function into the circuit automatically so that figures can be deciphered correctly. To accomplish this, the FIG key, in E position, is associated with the J key circuit. When depressed in E operation, the FIG key accomplishes two things: First, it sets up circuitry to permit figures to be enciphered, and, second, it enciphers a character to serve as an automatic switching device when depressed in D operation. Thus, the enciphered version of the figure function is actually a J.
  - (3) In D operation then, depression of the enciphered version of J automatically sets up circuits which decipher numerals correctly. It also produces a space on the paper tape to maintain the stepping pattern. The reason a space is printed rather than the J character is that spaces are less confusing in the deciphered text. The actual switching from the J key circuit to the space key circuit is accomplished in the sliding contact board (see fig. 18-C). The entire key action during E and D operation is such that if OVER-1459 were enciphered it would be deciphered as OVER--1459 (in which each dash (-) represents one space).
  - (4) Because the J key circuit is used for the figure function in E and D operation, the J key is combined with the Y key circuit during these operations to accomplish its own function.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

Therefore, the Y and J keys use the Y key circuit, and when the enciphered version of JUMPED is deciphered, it is reproduced as YUMPED. The combining of the Y and J circuits is accomplished by the sliding contact board (see fig. 18-B and 18-C).

- b. *Letter and V Key Circuits (fig. 19).*—These two circuits are combined to perform the letters function in encipher and decipher operation.

*Note:* Within the pulse generator, the coil for the V character is connected in series with the coil for the spacing function. The V coil is a low-pulse coil, while the space coil is a high-pulse coil (see subpar. 4006b(2)(b)3). Because of this arrangement, accidental depression of the V key in figures operation will cause a space to be recorded on the paper tape.

- (1) In P operation, both the LET and V keys perform their normal functions. Depression of the V key produces a V on the paper tape. Depression of the LET key extinguishes the neon glow lamp, and letters instead of figures are printed. The LET key produces no character on the tape.
  - (2) In E and D operation, however, the letters function must include an automatic switching device just as does the figures function. An enciphered V serves as the automatic switch that initiates the letters function in D operation. Thus, when the LET key is depressed in E operation it extinguishes the neon glow lamp and enciphers the letter V to represent the enciphered version of its own (letters) function. When the enciphered character is depressed in D operation, it automatically initiates the letters function and prints a space on the tape to maintain the stepping pattern. The result is that if 780-TIMES is enciphered it will be deciphered as 780--TIMES (in which each dash (-) represents one space).
  - (3) The reason a space rather than the character V is printed when the letters function is deciphered is due to the fact that the V and space coils are connected in an alpha-numeric arrangement, in which the V coil is the low pulse coil and the space is the high pulse coil. Since the machine continues to operate in the figures condition until after the letters function is complete, the high (space) pulse coil initiates printing.
  - (4) The enciphered versions of the V key and LET function are the same. The distinction between the two functions is made when deciphering. If the operator had intended to encipher the V key, the machine would logically have already been operating in letters condition. When deciphering, therefore, printing would be initiated on the low (letter) pulse coil of the V-space coil arrangement and the letter V would be printed.
- c. *Space, X, and Z Key Circuits (fig. 17).*

- (1) In P position, the X, Z, and space key circuits operate as normal key circuits and depression of either the X or Z keys, or the space bar, causes the respective character to be printed.
- (2) In E position, however, it is not possible to print spaces. (Those spaces inserted after every five letters are produced mechanically, not electrically.) Because the space circuit is eliminated in E operation, the space bar uses the Z key circuit to handle the space function. Therefore, either a space or Z produces an enciphered Z on the paper tape.
- (3) In D position, the circuit through the cipher unit for the enciphered space terminates on terminal EZ where it passes to the ZE pressure contact in the keyboard through a direct wire connection. The ZE contact is connected to K32 during D position, and K32 is wired through the space coil in the pulse generator, causing a space to be printed.

*Note:* Besides being tied to K32, one end of the space coil (at terminal Q1) is also tied to the positive end of the V coil (at terminal Q4) through the 9036 wire (see actual wiring diagram, fig. 61). This is the V-space pulse coil arrangement discussed in subparagraph 4006b(2)(b)3. The pulse transmitted through

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

K32 has no effect on the V coil and only a space pulse is transmitted. Since only the one pulse transmitted is a high pulse, printing is initiated regardless of whether the machine is operating in figures or letters.

- (4) The Z key is combined with the X key circuit in E position so that enciphered versions of X and Z are the same. Thus, when the enciphered version of LAZY is deciphered, it appears as LAXY.

**4107. Electronic Circuits.**—Printing and spacing in TSEC/KL-7 is a mechanical function that is initiated electrically by print and trip magnets. The energization of these magnets is governed and regulated by electronic components. A general description of this action is as follows:

*Note:* Tubes V101, V102, and V103 are shield-grid type thyratrons, in which the grid elements initiate conduction within the tube but do not control the amount of current flowing through the tube. Once such tubes begin to conduct, the plate or filament voltages must be cut off to stop conduction before the grids can regain control.

- a. Action in the electronic circuits is initiated by a pulse or pulses from the pulse generator applied to the primary winding of the transformer. These pulses are stepped up by the secondary in a ratio of 3 to 1 and applied to the control grid of the sharpener tube V102. Conduction in the sharpener tube V102 is determined by its grid bias and magnitude of the input pulse.
- b. The function of the sharpener tube is to distinguish between alpha and numeric pulses as determined by the bias on its control grid, and to sharpen the selected pulse before it is transmitted to the control grid of print tube V101. Pulses continue to be transmitted to the print tube as long as a key is held depressed, but the duration of the pulse transmitted by the sharpener tube is extremely short because tube cutoff time is almost instantaneous.
- c. To prevent the print tube from firing on transient pulses, or subsequent pulses other than the one selected pulse, a negative bias voltage is also applied to the shield grid of the print tube. The bias on the shield grid of the print tube is governed by the output of gate tube V104.
- d. Tube V104 is a single-shot multivibrator in which the low voltage on the plate of the normally conducting section appears at the shield grid of tube V101. At key closure, the single shot necessary to start the second half of the tube conducting is generated. A <sup>10</sup>15-millisecond time delay insures against removing the shield-grid bias before the efforts of the transient on the print tube is overcome.
- e. After the <sup>10</sup>15-millisecond time delay, bias is removed from the shield grid of the print tube and the tube fires on the next pulse to be received on its control grid. The print tube serves as an ON switch for the print and trip magnets, and printing, spacing, and rotor stepping takes place when this tube conducts.
- f. The function of the shift tube, V103, is to vary the bias on the control grid of the sharpener tube (V102) so that it will select the desired alpha or numeric pulse. When in figures operation, the shift tube makes the sharpener tube bias high so that only the numeric (high) pulse can cause the tube to conduct. In letters operation, the sharpener tube bias is low, thereby permitting the alpha (low) pulses to fire the tube.

**4108. Sharpener Tube V102.**—Tube V102 is a JAN 2D21 shield-grid thyatron which is used to distinguish between alpha and numeric pulses, to sharpen the selected pulse, and to transmit the sharpened pulse to the control grid of print tube V101.

- a. The plate of tube V<sup>102</sup>~~101~~ is connected through plate load resistor R111 to the unisolated, plus 200-volt supply line. The cathode is connected through resistor R120 to point W5 on resistor network R122, R121, and R119. The control grid input for the tube is tied to one side of the transformer secondary winding. The other side of this winding is tied to common.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

- b. When the tube is not ionized, current does not flow from its cathode to plate nor does it flow through resistor R120 which is in the cathode circuit. The cathode, therefore, represents the same electrical potential as terminal W5, the point to which it is connected to the resistor network. This voltage (assuming shift tube V103 is not conducting) is plus 8 volts. The algebraic difference between the potential at the grid, which is common, and this plus 8-volt value is minus 8 volts. Thus, the bias (which is the voltage difference between grid and cathode) is minus 8 volts.
- c. Capacitor C113 cuts off tube V102 almost instantly and also serves to rapidly restore B plus to the plate of the tube. The output of tube V102 is taken from the cathode (X5) and is coupled through capacitor C114 to the control grid of print tube V101. This is a cathode-follower action.
- d. At key closure, a single negative 10-volt pulse (assuming an alpha-numeric key has not been depressed) is applied to the primary winding of the transformer. The secondary of the transformer inverts the phase of this pulse and steps it up to a plus 30-volt value. This plus 30-volt pulse overcomes the minus 8-volt bias on the control grid of tube V102 and causes the tube to fire. When conducting, the tube may, for the purposes of this document, be considered a short circuit and capacitor C113, which is charged to the B plus value, discharges through the tube. The discharge of C113 causes the voltage at the cathode end of resistor R120 to increase (in a positive direction), and it is this higher voltage that is transmitted as a sharpened pulse to the control grid of the print tube through coupling capacitor C114. At the same time the cathode voltage of V102 is becoming more positive, the plate voltage is decreasing (becoming more negative) due to the flow of current through plate load resistance R111, with the result that the voltage difference between the plate and cathode quickly decreases to a value which will not sustain conduction through the tube. When this point is reached, the tube extinguishes. The duration of conduction through the sharpener tube is governed by the RC time constant of capacitor C113 and resistor R120, and is approximately 13.5 microseconds.
- e. Until full voltage is restored to the plate, tube V102 remains cut off. Any pulse transmitted from the pulse generator prior to recovery of this tube will have no effect, regardless of the magnitude of the pulse. Restoration of voltage to the plate of tube V102 begins immediately after the tube is cut off. Capacitor C113 begins to recharge through resistors R122, R121 and plate load resistor R111. When capacitor C113 is fully recharged, the tube is again ready to fire. Recovery time as determined by the RC time constant of the circuit is approximately ~~26~~ 20 milliseconds.
- f. When a transient pulse is generated at the instant of key closure, tube V102 fires. However, if the rotor of the pulse generator is in such position as to pulse a closed character coil prior to full recovery of tube V102, the generated pulse will not affect the sharpener tube. In fact, it is possible, to transmit a pulse from the pulse generator to the grid of V102 at any time up to ~~19~~ 19 milliseconds after key closure without affecting the tube. The tube will remain inert and the pulse generator rotor must make another complete cycle (requiring approximately 27 milliseconds) before transmitting another pulse which will fire the sharpener tube. In this particular case, (which is the absolute maximum), the time required from instant of key closure to the second firing of the sharpener tube is ~~46~~ 46 milliseconds. The minimum time in which the second firing can take place is ~~50~~ 50 milliseconds which occurs when the rotor is in such position at key closure that it does not pass a closed character coil until at least ~~20~~ 20 milliseconds has elapsed.

**4109. Gate Tube V104.**—Tube V104 is a JAN 12AX7 dual triode employed as a single-shot multivibrator, the output of which is applied to the shield grid of tube V101. The function of this output is to provide the shield-grid bias on tube V101 that prevents multiple cycling and the production of fly (undesired) characters.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- a. In a single-shot multivibrator, each trigger pulse initiates one complete cycle of operation at the completion of which the circuit returns to its quiescent (resting) state. It will then remain quiescent until triggered by another pulse. Without this pulse, the normally conducting half of the tube will continue to conduct while the portion normally cut off will remain non-conducting.
- b. The following conditions exist in tube V104 prior to key closure:
- (1) The A section of the tube is conducting; the B section is not. This is due to circuitry which places a more negative bias on the grid of the B section. That is, the cathode of the A section is tied directly to common while the grid is tied through resistor R123 to common. Since no current flows through R123, the potential on the grid is 0 volts. On the other hand, the grid of the B section is biased 14 volts negative because it is tied to point Y8 (on resistor network R125, R124, and R113), which is 14 volts negative.
  - (2) Capacitor C117 charges to the high plate voltage value of the nonconducting section B of the tube, while capacitor C118 charges to the low plate voltage value of the conducting section A. Capacitors C116 and C105 charge to the voltage value at terminal X3, which is in the isolated plus 220-volt supply line.
  - (3) Shield-grid bias for the print tube is taken from point X1 on resistor network R107, R112, and R113. Another point (X9) on this same resistor network is the plate of the A section of the tube. When tube V104A is conducting, the voltage at point X9 is low because of the heavy voltage drop through plate load resistor R113. If point X9 on the resistor network is low, point X1 on the network will be even lower because of its more negative position on the resistor network. With tube V104A conducting, potential at point X1 is minus 19 volts with respect to common. This is the bias voltage applied to the shield grid of the print tube V101.
- c. At key closure the potential at terminal X3 drops rapidly because the depressed key switch shorts one end of resistor R131 to common. Capacitor C105, the positive plate of which is tied to terminal X3, discharges through the closed key circuit causing the cathode end of resistor R126 to drop sharply negative. If the cathode goes negative, the control grid of tube V104B goes positive and the multivibrator cycle begins.
- (1) The lowered bias permits the B section of the tube to conduct, dropping its plate (X4) voltage through plate load resistor R117.
  - (2) The voltage drop at terminal X4 causes capacitor C117 to begin to discharge through resistor R123, dropping the grid end of this resistor towards negative. As the grid goes negative, the A section of the tube begins to cut off, causing tube V104A plate voltage to rise. This rise acting through resistor network R125, R124, and R113, makes the grid of tube V104B more positive, thereby causing the B section to conduct more heavily.
  - (3) Simultaneous with the emission of the trigger pulse (the discharge of capacitor C105) capacitor C116 also discharges owing to the voltage drop at terminal X3. This discharge, through resistor R112, drives point X1 (which is the same as the shield grid of tube V101) sharply negative. This action is known as the time delay and its purpose is to maintain sufficient bias on the shield grid for 15 milliseconds after key closure. By so doing, the gate is better timed to the recovery of the sharpener tube after firing by the transient pulse.
  - (4) After the time delay, the plate voltage of tube V104A, which is high when tube V104B is conducting, causes voltage to rise along the resistor network composed of R107, R112, and R113. This makes the voltage at point X1 on the resistor network and the bias on the shield grid of tube V101 correspondingly less negative. Actually, with the B section fully conducting and the A section fully cut off, shield grid bias rises to about 0 volts.

Note: Normally, the cycle of the multivibrator would complete itself by charging capacitor C118 to the high plate voltage on tube V104A. This charge would drive

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

the grid end of resistor R123 positive and tube V104A would again begin to conduct while tube V104B would begin to cut off. The action would continue until the cycle was complete and tube V104A was conducting and tube V104B was not conducting. However, because it is possible for stray pulses to be generated in the cipher unit which will trigger the gate more than once during a single key operation, the multivibrator circuit is not permitted to complete its normal cycle. Instead, it is opened through the repeat cam switch to prevent more than one triggering for each key operation. What could happen if the circuit were permitted to operate normally is explained in subparagraph (5) below.

- (5) The cipher unit in E and D position is in series with the key circuits. When the rotors step, contacts make and break causing an electrical action no different from opening and closing any key. Thus, during rotor stepping, it is possible to simulate a key closure which would permit capacitor C105 (if it had sufficiently recovered) to discharge and re-trigger the gate. If this second gate were on the shield grid of print tube V101 at the same time that the charge cam switch closes the circuit to the print magnet (which will happen when the timing cam rotates 350 degrees, see subpar. 4006g(3)(d)4), and if a pulse from the sharpener tube were produced at the control grid of tube V101, multiple cycling would occur.
- (6) To avoid the possibility of multiple cycling, the repeat cam switch is employed to provide an electrical interlock for the gate. The plate of tube V104A is tied to B plus through the actuating leaf of the repeat cam switch. Ten degrees after the timing cam begins to rotate, the actuating leaf of the repeat cam switch breaks the plate circuit of tube V104A, thus dropping the plate voltage and voltage at terminal X1 to the potential of the negative bias supply (minus 72v). By the time the timing cam has rotated 330 degrees, the rotor stepping action will have ceased. At this point, the repeat cam switch will close the plate circuit of tube V104A, thereby removing the negative bias on the shield grid of tube V101 and the gate tube will be ready for the next key operation.

**4110. Print Tube V101.**—The print tube V101 is a JAN 2D21 shield-grid thyratron which serves as an off-on switch for the trip and print magnets.

- a. *Circuit.*—The control-grid input is provided through coupling capacitor C114 from the cathode of sharpener tube, V102. The shield-grid input is provided from point X1 on resistor network R107, R112, and R113. The cathode is connected directly to common, and voltage for the plate is obtained from the unisolated 200-volt supply through the charge cam switch, keyboard, and print magnet. Bias for the control grid is obtained from point V1 on resistor network R106 and R105, which is connected across the negative bias supply. The voltage at point V1 is minus 27 volts.
- b. *Print and Trip Capacitors.*—The print capacitors, C101 and C102, and trip capacitors, C106 and C107, are connected between common and the unisolated high voltage supply. When the print tube is not conducting, these capacitors are charged to the plus 200-volt potential of the high-voltage supply. Resistor R129 is a bleeder resistor which assures discharge of the print and trip capacitors when the machine is turned off.

*Note:* In addition to serving as a triggering device for the print and trip magnets, the print and trip capacitors also serve to filter the DC output of the full-wave rectifier.

- c. *Circuit Action.*—Print tube V101 functions as follows:
  - (1) ~~Fifteen~~<sup>15</sup> milliseconds after key closure, the action of the gate tube (see subpar. 4109c(3)) increases voltage at the shield grid of tube V101 sufficiently to overcome the negative bias.
  - (2) When the shield grid bias on tube V101 is removed, the print tube will conduct when triggered by a pulse from the sharpener tube. This pulse is received on the control grid ~~20~~<sup>20</sup> to ~~46~~<sup>46</sup> milliseconds after key closure, and the print tube will fire.

37

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (3) When the print tube conducts, it presents an easy discharge path for the print and trip capacitors. This discharge energizes the print and trip magnets and initiates the printing and stepping functions. The trip capacitors discharge through the print and trip magnets, while the print capacitors discharge only through the print magnet. The extra power received from the trip capacitors provides the high striking force necessary for clear, sharp printing.
- (4) When the print tube conducts, the plate-cathode resistance is low and the voltage difference between the plate and cathode is also low. In addition, the heavy discharge of the print and trip capacitors generates a considerable cemf in the print magnet, the effect of which is to drive the plate momentarily negative with respect to its cathode (common). The net effect of these actions is that the print tube cuts itself off almost instantaneously after it begins to conduct.
- (5) Although the print and trip magnets energize practically instantaneously with the firing of the print tube, the mechanical action initiated by these magnets is not. It requires approximately 2 milliseconds for the print hammer to strike, and a slightly longer time is required to trip the cycling phase. After turning 10 degrees, however, the timing cam opens the plate circuit of the print tube and accomplishes the following two functions:
  - (a) It prevents multiple cycling caused by spurious electronic action by opening the plate circuit.
  - (b) By shorting resistor R110 (in series with the output of the full-wave rectifier), plate voltage is restored to the print and sharpener tubes more rapidly, in preparation for the next key operation.
- (6) The purpose of capacitor C109 (connected in parallel with the trip magnet) is to minimize the resonant effects of the trip magnet, thereby preventing multiple printing due to oscillations generated in the trip magnet by the heavy discharge current.

d. *Automatic Rotor Stepping.*—When the selector handle is moved from P to E position, the rotors automatically step as they would in any E or D operation. This is accomplished by shorting contact K21 to K20 in the keyboard (see fig. 14-E), which permits the trip capacitors to discharge through the trip magnet. Resistor R129 is a current limiting resistor whose purpose is to reduce burning of the contacts due to the heavy discharge current. Simultaneous with the discharge through the trip magnet, a circuit through the rotor stepping magnets is also completed in the keyboard by means of an elongated connecting bar. This bar <sup>completes</sup> ~~common to one side of all~~ rotor stepping magnets through contact K11 (see fig. 14-C). ~~Individual rotor stepping magnets energize when circuits are completed through actuator switches to terminal B3, the positive return point in E and D operation. The selected magnets cause rotors to step in their normal pattern.~~  
~~the plus 14-volt circuit to B3 as the~~

e. *Tube V101 Plate Circuit Interlock.*—When power in TSEC/KL-7 is turned off, control and shield grid biases on the print tube drop to zero more rapidly than the plate voltage. This could cause the print tube to fire when the machine is turned off. To prevent this, the plate circuit of the print tube is routed through the keyboard and as the selector handle passes to the O position, the sliding contact board opens the plate circuit and cuts off the plate voltage, thereby preventing firing of the tube. Actual circuitry for this action is accomplished by breaking contact K3 (which is connected to the print magnet) from K4, which is connected to the charge cam switch (see fig. 14-B).

f. *Repeat Function.*—Shield-grid bias on the print tube is determined by the potential at point X1 on resistor network R107, R112, and R113. Normally, the voltage at X1 is dependent upon the action of the plate of tube V104A. However, closing the RPT key connects point X1 on the resistor network to common, which removes the negative bias from the shield grid. With bias removed, only the control grid bias prevents the tube from conducting. The print tube is then free to fire every-time a pulse from the pulse generator triggers the sharpener tube. The sharpener tube will continue to transmit pulses to the print tube for as long as a key is

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

held depressed. The key selected for repetition must be depressed before the RPT key is depressed. If not, the RPT key removes shield grid bias permitting the transient generated by key closure to initiate printing. Actual circuitry for the RPT key is accomplished through contact K19 in the keyboard which is connected to terminal X1. Contact K18 is wired to contact K19 and a special T-shaped contact makes contact possible between RPT key and either K18 or K19 in P, E, or D position (see fig. 14-D).

**4111. Shift Tube V103.**—This is a JAN 2D21 shield-grid thyratron which determines the control grid bias for the sharpener tube V102 so as to permit distinction between letter and figure pulses of the alpha-numeric key circuits.

- a. *Alpha-Numeric Pulse Coils.*—There are two types of pulses transmitted by the pulse generator (see subpar. 4006b(2)(b)). One is a high-amplitude (10-volt) pulse; the other, a low amplitude (5-volt) pulse. All figures, the space function, and those letters not included as part of an alpha-numeric function (see fig. 22-B) transmit high pulses. Those letters which are included as part of the alpha-numeric function and the V key transmit low pulses. The low pulse (letter) and the high pulse (figure) coils of each alpha-numeric key circuit are connected in series with one another in the pulse generator (see fig. 22). When an alpha-numeric key is depressed, the circuit for both a high- and low-pulse coil is completed. When the rotor passes the low-pulse coil, a negative-going, 5-volt pulse is applied to the primary of the transformer. When the rotor passes the high-pulse coil, a negative-going, 10-volt pulse is produced.
- b. *Selection of Letter or Figure Functions.*—The sharpener tube receives the stepped-up low pulse as a 15-volt, positive pulse. If the machine is in letter operation, this pulse is sufficient to overcome the minus 8-volt bias on the sharpener tube control grid and the tube fires. A few milliseconds later, the high pulse is received at the control grid of the sharpener tube but has no effect because of the time (20 milliseconds) required for the sharpener tube to recover. Thus, printing is initiated by the low pulse and a letter is printed on the paper tape. When the machine is operating in figures condition (see note below), the bias on the control grid of the sharpener tube is made more negative than when in letters operation. The low pulse, which reaches the grid first, is not sufficient to fire the tube. The high pulse which follows, however, is sufficient and the tube fires, and a figure is printed on the paper tape.

*Note:* The bias at the sharpener tube control grid can be increased only in the P or D position. In E position, the bias remains low enough to fire on letter pulses and only letters can be printed (see subpar. f below).

- c. *Sharpener Tube Control-Grid Bias.*—Bias on the control grid is determined by the voltage at point W5 on resistor network R122, R121, and R119 (see subpar. 4108b). In turn, the potential at terminal W5 is determined by the current through these resistors. Increasing the current flow increases the voltage at this point (W5) proportionately. The primary function of tube V103 is to control this current flow. Tube V103 is in parallel with resistors R121 and R119, and this parallel combination is in series with R122. When the shift tube fires, the current through R119 and R121 changes due to the increased current through R122. This change causes a greater voltage drop between common and terminal W5, with the result that the control grid bias for the ~~shift~~<sup>sharpener</sup> tube becomes more negative.
- d. *Shift Tube V103 Circuit.*—Plate voltage for tube V103 is supplied through plate load resistor R116. A neon glow lamp is connected in parallel with cathode voltage dropping resistor R130. Capacitor C120, also in the cathode circuit, functions to overcome phase differences caused by distributed circuit capacities. The cathode circuit is routed through the keyboard, where it is switched to either point V6 on resistor network R122, R121, and R119, or to common through resistor R133. Grid bias sufficient to prevent tube V103 from firing is developed by the negative voltage supply across the resistor network consisting of R104, R103, and R118. Capacitor C111 and resistor R132 serve to stabilize the voltage at the grid of tube V103.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

*e. Figures Operation in P Position (fig. 15-A).*

- (1) Depression of the FIG key shorts the voltage developed across resistor R104 to common. The voltage across resistor R103 then becomes more positive and permits the tube to fire. Current flow through the cathode circuit causes a sufficient voltage drop across resistor R130 to fire the neon glow lamp. The glowing lamp indicates to the operator that the machine is now in figures operation.
- (2) In P position, the cathode is tied through the keyboard to point V6 on resistor network R122, R121, and R119. When tube V103 conducts, it becomes a current path in parallel with resistors R121 and R119. This increases the sharpener tube control grid bias to a value greater than the amplitude of a letter pulse. As a result, only figures are printed (see subpar. c above).

*f. Figures Operation in E Position.*

- (1) Depression of the FIG key in E position closes a circuit to the actuating leaf of the figures cam switch. The actuating leaf is initially connected to the J key circuit and causes enciphered versions of the letter J to be printed (see subpar. 4106a). Ten degrees after the timing cam begins to rotate, the actuating leaf is disconnected from the J circuit and is connected to the grid circuit of tube V103 (see encircled reference 3 on schematic). When this occurs, bias from the negative bias supply is shorted to common and the bias developed across resistor R103 rises sufficiently to permit tube V103 to conduct.
- (2) In E position, the cathode of tube V103 is not tied to the resistor network that governs sharpener tube control grid bias. Instead, the cathode is tied to common through resistor R133. This switching is accomplished in the keyboard (fig. 15-B). The resultant current flow through resistor R130 fires the neon glow lamp, just as in P position (see subpar. e(1) above). It does not, however, affect the sharpener tube V102 bias. In E operation, therefore, figures operation is indicated while letters only are printed (see subpar. 4106a(2)).

*g. Figures Operation in D Position.*

- (1) When the key representing the enciphered version of the figures function is depressed, it is deciphered in the cipher unit and routed through the J key circuit to the actuating leaf of the figure cam switch. Prior to tripping of the timing cam by the trip magnet, the actuating leaf is connected to the space key circuit. A space prints and the trip magnet initiates rotation of the timing cam. After rotating 10 degrees, the timing cam disconnects the actuator from the space key circuit and connects it to the grid circuit of shift tube V103. At this instant, negative bias from resistor R104 is shorted to common which permits the voltage across resistor R103 to rise sufficiently to fire tube V103.
- (2) In D position, the cathode circuit is basically the same as it is in P position. That is, the cathode is tied to the resistor network that governs the bias for the sharpener tube. When tube V103 conducts, the voltage through the resistor network is altered and the bias on the control grid of sharpener tube V102 is changed.
- (3) In E operation, initiation of the figures function does nothing but ignite the neon glow lamp to indicate that any figure key depressed when the lamp is lighted will be enciphered as a letter. In D operation, however, depression of the enciphered version of the figures function *does* accomplish circuit changes (for example, when the enciphered version of the Q-1 key is depressed the figure 1 prints).

*Note:* Under no circumstances should a figure appear on an enciphered tape, not even as the enciphered version of another character.

*h. Letters Function in P Position.*

- (1) In P position, closure of the LET key connects common to the plate of tube V103 through capacitors C115 and C112. Because an inherent property of an uncharged capacitor is

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

to momentarily offer a very low resistance to DC, the plate voltage of tube V103 drops to practically zero. This causes V103 to cease conducting. Resistor R115 permits the charge on C115 and C112 to equalize when the LET key is released. (If the charge were permitted to remain, the figures function could still be achieved but reinitiation of the letters function could not.)

- (2) Once tube V103 cuts off, the current through resistor network R122, R121, and R119 decreases, thereby returning the machine to letters operation (see subpar. c above). No character is printed on the paper tape when the LET key is depressed in P position.
  - (3) Since no current flows through the cathode resistor R130 when tube V103 is cut off, the voltage that maintains ionization in the neon glow lamp disappears and the lamp goes out.
- i. *Letters Function in E Operation.*—Depression of the LET key in E position closes a circuit to the actuating leaf of the letter cam switch. The actuating leaf is connected initially to the V-space key circuit and, since the machine is operating in figures condition to justify the letter shift, the high (space) pulse coil initiates printing. (At this point, tube V103 is still conducting and the machine is still in figures condition). Ten degrees after the timing cam begins to rotate, the actuating leaf is disconnected from the space key circuit and connected to the plate circuit of tube V103 (see encircled reference 4 on schematic wiring diagram). Once the actuating leaf connects to the plate circuit, the LET key functions as in P operation and drops the plate voltage to nearly common, thus extinguishing the tube. Since the figures operation in E position is only indicated, as explained in subparagraph f(2) above, LET key closure has no effect other than to extinguish the neon glow lamp.
  - j. *Letters Function in D Operation.*—Operation in D position is similar to that described for E position. The key representing the enciphered version of the letters function is depressed, is deciphered in the cipher unit, and terminates on the V-space key circuit. Since the machine is logically operating in the figures condition when the LET key is depressed, printing is initiated on the high (space) coil. The timing shaft rotates 10 degrees and the actuating leaf of the letter cam switch disconnects from the key circuit and connects to the plate of shift tube V103, thereby connecting the plate of the tube to common.

*Note:* In D position, the cathode of shift tube V103 is tied through the resistor network that governs control grid bias on the sharpener tube. Extinguishing the shift tube, therefore, decreases the negative bias sufficiently to permit letters to print. The neon glow lamp is also extinguished.

**4112. Power Circuit.**—TSEC/KL-7 utilizes two basic power sources: One is the output from a high-voltage AC generator and the other is a low DC voltage.

- a. The low voltage can be provided either by the CE 87066 power converter or a direct battery installation. The low voltage is used to operate the motor, tube filaments, and rotor stepping magnets.
- b. The high-voltage output from the AC generator is rectified by a full-wave, bridge-type rectifier composed of germanium diodes to provide the high DC voltage necessary to meet the plate voltage requirements of the electronic circuits. A half-wave rectifier is used to provide negative bias voltage for the tubes.

**4113. CE 87066 Power Converter (fig. 64).**—The power converter is designed to change either 100-125-volt, or 200-250-volt, 50-60-cycle AC power to 21-31-volt DC power. To utilize either input voltage range, the primary of the power transformer in the converter uses two windings. For 100-125-volt operation, the two windings are connected in parallel. For 200-250-volt operation, a changeover switch (on the power converter) connects the two primary windings in series. Since

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

the output voltage at the secondary is inversely proportional to the turns ratio (the higher the turns ratio, the lower the output voltage), doubling the number of primary turns maintains the same output voltage when the primary voltage is doubled. The output of the power transformer is rectified by two full-wave selenium rectifier stacks connected in parallel and appears at the output receptacle as a pulsating DC. The power applied to the TSEC/KL-7 cipher machine may also be obtained from a battery source provided that the voltage can be maintained within the 21- to 31-volt range (24 volts is considered ideal) under dynamic operating conditions.

**4114. Common Return.**—All power and signal circuits of TSEC/KL-7 utilize a common return circuit. This return circuit is the negative side of the DC input and plate voltage power sources, and the positive side of the bias voltage supply. The negative terminal (B) of the DC power input receptacle is connected to terminal C16, as is the negative terminal (W11) of the full-wave bridge plate voltage supply rectifier. The positive terminal (U1) of the bias voltage supply is also connected to terminal C16. All key switches in the keyboard are returned to C16 through contact K44 by a direct wire connection. Thus, terminal C16 may be used as a reference for tracing any circuit in the machine.

**4115. Low-Voltage Supply.**

- a. The electrical input circuit to the motor, the tube filaments, and the rotor stepping magnet circuit are all in parallel and are all tied between a point on common and pin A of the power cord receptacle. The low voltage DC input is applied across all three circuits, between pin B (common) and pin A.
- b. The circuit through the tube filaments utilizes shunt resistors R101 and R102 to maintain correct voltages across the tube filaments. Shunt resistor R102 is connected in parallel with tube filaments V102 and V103, and these filaments are in series with one another. Shunt resistor R101 is connected in parallel with tube filaments V104A and V104B and these filaments in parallel with one another. The filament for tube V101 is not shunted and is connected in series with the other filaments with their shunt resistances. The shunting resistors are used to obtain the desired voltage and current distribution throughout the filament circuit.
- c. The motor used in TSEC/KL-7 is a shunt-wound DC motor (see subpar. 4006a). Resistors R202 and R201, and the motor field, are connected in series across the motor brushes and armature. The low DC voltage source is connected through terminals N1 and N2 to the brushes of the motor.
- d. The circuit through the rotor stepping magnets is discussed separately in paragraph 4117.

**4116. High-Voltage Supply.**—The generator and motor are contained in the same housing. In fact, the motor armature and generator rotor are fastened to the same shaft (see subpar. 4006a(1)). Thus, when the motor turns, the generator rotor also turns. The generator rotor is a permanent magnet which, when it rotates, induces a voltage in the stationary field coils. The circuit for the field winding of the generator is closed through the full-wave rectifier, and the induced voltage causes an AC flow. This AC is converted by the bridge rectifier to pulsating DC, which is then filtered by capacitors C101, C102, C106, and C107. The filtered output provides an essentially pure DC supply for the electronic circuits. Individual power supplies derived from the high DC output voltage of the rectifier are as follows:

- a. *Unisolated 200-volt Supply.*—This source is connected to the full-wave bridge rectifier through resistors R109 and R110. It provides plate voltage for tubes V101, V102, and V104A. It also provides print capacitors C101 and C102, and trip capacitors C106 and C107 with sufficient potential to initiate the print and cycling phases. Tube V104A is tied to this supply line through the repeat cam switch. Resistors R109 and R110 are isolating and voltage dropping resistors which prevent the heavy drop in plate voltage at the print tube from seriously affecting the potential at the output of the rectifier in addition to dropping the output to the desired voltage.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

- b. *Isolated 220-volt Supply.*—This line is connected through isolating diodes D103 and D104 to the full-wave bridge rectifier. It supplies plate voltage for the shift tube V103, and gate tube V104B. When tube V101 fires, its plate voltage drops rapidly (see subpar. 4110c). If it were not for these blocking diodes, the drop in the plate of tube V101 could cause the plate voltage at tube V103 to drop sufficiently to extinguish the tube, thus prematurely effecting letters operation. Capacitors C119 and C104 smooth the output of the isolated 220-volt supply.
- c. *Negative Bias Supply.*—The negative bias supply provides bias for the control grids of print tube V101, shift tube V103, and gate tube V104B. This supply is 72 volts negative with respect to common.
- (1) The elements of the bias supply are: Resistor R128, across which the AC to be rectified is developed; filter capacitor C108; AC input coupling capacitor C103; and half-wave rectifier (composed of diodes D113, D114, and D116).
  - (2) The operation of the half-wave rectifier may be described as follows: The AC high voltage generator alternately drives terminal Y2 positive and negative. When Y2 is positive, electrons flow from common through resistor R128 and capacitor C103 to the positive side of the generator windings. Little current flows through the half-wave rectifier because the diodes offer a high impedance to current flow in this direction.
  - (3) On the next half cycle, Y2 becomes negative. Capacitor C103 has a short discharge time with respect to the frequency of the AC generator and discharges through the low impedance offered by the diode rectifiers to current in this direction. In addition, electrons will flow from the negative side of the generator windings through the half-wave rectifier. These two currents charge capacitor C108 so that terminal X12 is negative with respect to common. The large capacitance of C108 provides a filtering action for the half-wave rectifier that considerably smoothes the half-wave output of the rectifier. Thus, a satisfactory DC level, which is 72 volts negative with respect to common, is developed at terminal W1. This output is fed to the grids of grid biased tubes through various resistors.

**4117. Rotor Stepping Magnet Circuits (fig. 62 and 63).**—Each of the seven movable rotors in the stepping unit is controlled by a rotor stepping magnet. When a stepping magnet energizes, its associated rotor steps one position. The magnets can be energized in P, E, and D positions. In P position, each magnet is directly controlled by a set key, and depression of the set key in front of a particular rotor causes the associated rotor magnet to advance that particular rotor. The set keys are used to align the rotors to the correct initial position. In E and D positions, the magnets are energized through actuator switch buttons. When a lobe on a rotor presses against a switch button, the button disconnects a swinger on the top section of its associated actuator switch from one contact leaf and connects it to another. Which rotor stepping magnets are energized in a particular operation is determined by the circuit through the actuator switches. The circuit is so designed that at least three rotors step for each machine operation in E or D position.

- a. *General.*—Each movable rotor is associated with an actuator switch and a rotor stepping magnet. The numerical designations of associated components, from left to right in the stepping unit, are as follows:
- (1) The No. 1 rotor is associated with actuator switch S301 and rotor stepping magnet L301.
  - (2) The No. 2 rotor is associated with actuator switch S302 and rotor stepping magnet L302.
  - (3) The No. 3 rotor is associated with actuator switch S303 and rotor stepping magnet L303.
  - (4) The No. 4 rotor is stationary and therefore has no associated actuator switch or rotor stepping magnet.
  - (5) The No. 5 rotor is associated with actuator switch S304 and rotor stepping magnet L304.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (6) The No. 6 rotor is associated with actuator switch S305 and rotor stepping magnet L305.
- (7) The No. 7 rotor is associated with actuator switch S306 and rotor stepping magnet L306.
- (8) The No. 8 rotor is associated with actuator switch S307 and rotor stepping magnet L307.
- b. *Actuator Switches.*—Each of the seven actuator switches is composed of two sections. The bottom section, the swinger for which is controlled by the set key; and the top section, the swinger for which is controlled by an actuator switch button. (See subpar. 4007a(6), (7), and (8) for detailed mechanical description of how set keys and actuator switch buttons make and break individual circuits.
- c. *Fixed Connections in Rotor Stepping Unit.*
- (1) *Common, B2.*—One end of all rotor stepping magnet windings is connected to common through terminal B2 in the rotor stepping unit. The other end of each winding is connected to leaf No. 2 in each of the seven actuating switches. Thus, when a positive potential is applied to leaf No. 2, the associated rotor stepping magnet energizes.
- (2) *Trip magnet, B1.*—In addition to being connected to terminal B2, common is also connected through the trip magnet and terminal B1 to leaf No. 1 of each of the seven actuator switches. When a positive source of power is applied to leaf No. 1, the trip magnet energizes and cycles the machine.
- (3) *Positive source of 24 volts in P operation, B4.*—In P position, positive 24 volts is applied to the No. 4 leaf of each actuator switch. When a set key is depressed, 24 volts is applied first to the associated rotor stepping magnet, and then to the trip magnet. This action causes the rotor stepping magnet to energize and the associated rotor to step. Leaf No. 4 gets its potential from terminal B4 and K13 on the keyboard. (In P position, the sliding contact board connects terminal K13 to K12, which, in turn, is connected to K1, the positive input terminal of the machine.)
- (4) *Positive source of 24 volts in E and D operation, B3.*—In E and D operation, plus 24 volts is removed from leaf No. 4 and applied through terminal B3 to various leaves of the actuator switches. In the stepping unit itself, positive 24 volts in E and D position is applied directly to leaf No. 6 of all actuator switches except S304 and S307. It is applied to leaf No. 6 of these switches (S304 and S307) only when leaf No. 7 of switch S303 is connected to leaf No. 6 of switch S303.
- d. *Rotor Stepping.*—The pattern for rotor stepping is determined by individual rotor notch rings. When a rotor steps so that a lobe on its notch ring rides against an actuator switch button, the button depresses leaf No. 6 of its associated actuator switch. Leaf No. 6 is the swinger for the top section of each actuator switch and its action completes circuits through the stepping unit that energize the rotor stepping magnets in a definite but confused pattern. The pattern is as follows:
- Note:* In the following explanation, it is assumed that when a rotor is "not notched" a lobe on its notch ring is pressing against the actuator switch button so as to cause it to move the swinger of the top section of the associated actuator switch. Conversely, the "notched" condition assumes that the rotor is positioned so that the actuator switch button falls into one of the notches of the notch ring, thereby permitting the swinger to remain in its uppermost position.
- (1) The No. 1 rotor steps if the No. 2 and/or No. 3 rotors are notched and the No. 8 rotor is notched.
- (2) The No. 2 rotor steps if the No. <sup>5</sup>6 rotor is notched and/or the No. <sup>4</sup>7 rotor is notched.
- (3) The No. 3 rotor steps if the No. <sup>6</sup>7 rotor is not notched and/or the No. 2 rotor is not notched.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

- (4) The No. 4 rotor is stationary.
- (5) The No. 5<sup>4</sup> steps if the No. 2 rotor and/or the No. 3 rotor is notched.
- (6) The No. 6<sup>5</sup> rotor steps if the No. 1 rotor is notched and/or the No. 3 rotor is not notched.
- (7) The No. 7<sup>4</sup> rotor steps if the No. 1 rotor is not notched and/or the No. 6<sup>5</sup> rotor is not notched.
- (8) The No. 8<sup>7</sup> rotor steps if the No. 2 rotor and/or the No. 3 rotor is notched and the No. 5 rotor is notched.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## CHAPTER 5 CIRCUITS

### 5000—GENERAL

**5001. Classification of Circuits.**—The electrical wiring of TSEC/KL-7 may be divided into four groups of circuits for instructional purposes. These are as follows:

- a. *Key Circuits.*—These circuits select individual character pulses to initiate printing on the paper tape. They are also used to select machine functions such as letters, figures, and repeat operations.
- b. *Tube Circuits.*—The electronic components of TSEC/KL-7 serve to regulate and time machine operation.
- c. *Power Circuits.*—These circuits provide the necessary power for both electrical and mechanical functions. The machine is designed for a DC input voltage of 24 volts, but will operate over the range of 21–31 volts.
- d. *Rotor Stepping Circuits.*—These circuits cause the rotors to step in an intricate, predetermined pattern.

### 5002. Circuit Tracing Aids.

- a. The actual wiring diagrams, figure 61 for the machine, and figure 63 for the stepping and cipher units, may be used in tracing circuits described in this chapter. Schematic wiring diagram (fig. 60) may be used as an aid to understand the functions of the various electrical circuits.
- b. Tables of data on electrical characteristics of the circuits are provided in section 5500.
- c. Charts are provided to facilitate point to point tracing of all circuits. Each succeeding "Step No." listed in a chart indicates that the previous step number is in series with it. For example Step No. 1, No. 2, and No. 3 are all in series. Where parallel paths are involved, a coding system of suffixing letters to the step number identifies each leg of the path. For example: Steps No. 2a, 2b, and 2c indicate that a parallel path starts at the point indicated in Step No. 2.
- d. Before proceeding with the text of this chapter it is well to be familiar with terminal designations of each assembly. These may be found in figure 58, the contact panel.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

5100—KEY CIRCUITS

5101. General.

- a. Each lettered key, and the space bar, are in reality single-pole, single-throw switches of the spring-return push-button type. Depressing any key (or the space bar) therefore, closes a circuit from common, through the associated circuit, back to common.
- b. For descriptive purposes, the key circuits are divided into two groups: normal key circuits and special key circuits.
  - (1) A normal key circuit may be defined as one which is independent of any other key circuit in its operation. There are 21 normal key circuits, which are as follows: A, B, C, D, E-3, F, G, H, I-8, K, L, M, N, O-9, P-0, Q-1, R-4, T-5, U-7, and W-2.
  - (2) A special key circuit may be defined as one which is *not* independent of another key circuit. There are nine such special key circuits, as follows: J, V, X, Y-6, space bar, FIG, LET, and RPT.

5102. Normal Key Circuits.—The purpose of a normal key circuit is to initiate a pulse of proper magnitude that will cause printing action to take place.

a. Plain Text Operation.—Assuming the K key switch has been depressed, the circuit is as follows:

Step No.	From	Through	To
1.	C16 (Common)	O wire	K44
2.	K44	O wire	K6 (Common post in keyboard)
3.	K6	Closed K key switch and T contact	KP
4.	KP	One wire of 27-wire cable	PK
5.	PK	Contact	QK
6.	QK	K pulse coil	Q3
7.	Q3	Contact	P3
8.	P3	9081 wire	P2
9.	P2	9081 wire	V14
10.	V14	D115	U14
11.	U14	9066 wire	U7
12.	U7	D101	V7
13.	V7	D102	W7
14.	W7	9151 wire	C7
15.	C7	Primary winding of T101	C14
16.	C14	Bus wire	C13
17.	C13	O wire	C9
18.	C9	Bus wire	C16 (Common)

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

b. *Encipher Operation.*—The circuit in E operation is the same as for P operation, except that the cipher unit is added in series with the key switch. Again assuming the K key switch has been depressed, the circuit is as follows:

Step No.	From	Through	To
1.	C16 (Common)	O wire	K44
2.	K44	O wire	K6 (Common post in keyboard)
3.	K6	Closed K key switch	KE
4.	KE	One wire of 26-wire cable	EK
5.	EK	Cipher unit, including eight rotors	9 (Assumed reenty point) on decipher side of cipher unit
6.	9	9253 wire	9 on encipher side of cipher unit
7.	9	Cipher unit, including eight rotors	DG (Assumed)
8.	DG	One wire of 26 wire cable	GD
9.	GD	Connecting bar	GP
10.	From this point the circuit is similar to that described for a normal key circuit, in P operation. (See subpar. a above, steps 4 thru 18.)		

c. *Decipher Operation.*—The circuit in D operation is similar to that described for E operation (see subpar. b above), except that it is routed through the opposite side of the cipher unit. Assuming the enciphered version of the K key switch (i. e., the character G as described in subpar. b above) has been depressed, the circuit is as follows:

Step No.	From	Through	To
1.	C16 (Common)	O wire	K44
2.	K44	O wire	K6 (Common post in keyboard)
3.	K6	Closed G key switch	GD
4.	GD	One wire of 26-wire cable	DG
5.	DG	Cipher unit, including eight rotors	9 on encipher side of cipher unit
6.	9	9253 wire	9 on decipher side of cipher unit
7.	9	Cipher unit, including eight rotors	EK
8.	EK	One wire of 26-wire cable	KE
9.	KE	Connecting bar	KP
10.	From this point the circuit is similar to that described for a normal key circuit, in P operation. (See subpar. a above, steps 4 thru 18.)		

5103. *Special Key Circuits.*—Special key circuits are necessary to encipher and decipher functions such as figures, letters, and spaces. The repeat key circuit is also considered to be a special

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

key circuit, its purpose being to set up circuitry which will permit continuous printing of any given character in its plain-text, enciphered, or deciphered versions.

a. *Repeat Key Circuit.*

- (1) Depression of the RPT key after depression of any other character key permits the machine to cycle continuously. In P position, this results in printing of a continuous succession of the character represented by the depressed key. In E position, the result is a succession of five-letter groups representing the enciphered version of the depressed key. In D position, the result is a continuous succession of the deciphered versions of the depressed key.
- (2) When the RPT key is depressed a circuit is completed which connects the shield grid of the print tube to common, thus permitting the print tube to fire whenever a pulse is received from the sharpener tube.
- (3) In P position, the circuit for the RPT key is as follows:

Step No.	From	Through	To
1.	C16 (Common)	O wire	K44
2.	K44	O wire	K6 (Common post in keyboard)
3.	K6	Closed RPT key switch	K18
4.	K18	Bus wire	K19
5.	K19	9636 wire	X1
6.	X1	9636 wire	U3
7.	U3	9636 wire	Pin 5, V101

- (4) The circuit for the RPT key in E position is the same as that in subparagraph (3) above. A special T-shaped contact mates the RPT key to K18 even though the contact board has been shifted.
- (5) The circuit for the RPT key in D position is the same as that described in subparagraph (3) above, except that instead of the circuit being completed first to terminal K18 and then by bus wire to terminal K19, the circuit is completed directly to terminal K19.

b. *Figure Key Circuit.*—The purpose of this circuit is to overcome bias on shift tube V103 and thus cause the shift tube to conduct.

- (1) In P position, depression of the FIG key completes a circuit directly between common and the control grid of tube V103. The circuit is as follows:

Step No.	From	Through	To
1.	C16 (Common)	O wire	K44
2.	K44	O wire	K6 (Common post in keyboard)
3.	K6	Closed FIG key switch	K30
4.	K30	9253 wire	S30
5.	S30	9253 wire	C4

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

6.	C4	R108	C11
7.	C11	9166 wire	U6
8.	U6	9166 wire and R132	Pin 1 of V103

(2) In E position, depression of the FIG key accomplishes two things. First, a letter is printed which represents the enciphered version of the figures function. Secondly, tube V103 and its associated neon glow lamp, N101, fire. However, because of a switching arrangement in E position, tube V103 has no effect on the circuit other than to indicate through the neon glow lamp that the machine is operating in figures condition. (Note that the enciphered version of the J and FIG keys is the same.) The circuit is as follows:

Step No.	From	Through	To
1.	C16	O wire	K44
2.	K44	O wire	K6 (Common post in keyboard)
3.	K6	Closed FIG key switch	K29
4.	K29	9236 wire	K33
5.	K33	9236 wire	S31
6.	S31	Contact	T31
7.	T31	9236 wire	Actuating leaf of FIG cam switch
8.	Actuating leaf of FIG cam switch	9250 wire	T32
9.	T32	Contact	S32
10.	S32	9250 wire	K34
11.	K34	Connecting bar	JE
12.	From this point the circuit is similar to that described for a normal key circuit in E operation. (See subpar. 5102b, steps 4 thru 10.)		
8a.	Actuating leaf of FIG cam switch	9253 wire	T30
8b.	T30	Contact	S30
8c.	From this point the circuit is similar to that described for the figure key circuit in P operation. (See subpar. b above, steps 5 thru 18.)		

(3) During decipher operation, the shift to figures condition can be accomplished in either of two ways.

(a) The first is by depression of the FIG key switch. This method, however, is not truly a deciphering function and merely serves to shift the machine to figures condition when letters are printing and figures are desired. The circuit for this is the same as that described in subparagraph b(1) above except that instead of being completed to terminal K30 (see step No. 4), closure of the FIG key switch completes a circuit to terminal K31 which is wired to K30.

~~CONFIDENTIAL~~

(b) The second method of shifting to figures condition is by deciphering the enciphered version of the figures function. For example, if the character S were the enciphered version, depression of the S key switch during D operation results in firing of shift tube V103 and its associated neon glow lamp N101. In addition, a space would print on the paper tape. The purpose of printing a space rather than omitting the printing function altogether is to cycle the machine, thus, maintaining the stepping pattern. The circuit is as follows:

Step No.	From	Through	To
1.	The circuit follows a path similar to that described for a normal key circuit, in D operation. (See subpar. 5102c steps 1 thru 8.)		
2.	JE	Connecting bar	K33
3.	K33	9236 wire	S31
4.	S31	Contact	T31
5.	T31	9236 wire	Actuating leaf of FIG cam switch
6.	Actuating leaf of FIG cam switch	9250 wire	T32
7.	T32	Contact	S32
8.	S32	9250 wire	K34
9.	K34	9250 wire	K7
10.	K7	Connecting bar	K8
11.	K8	9036 wire	K32
12.	K32	One wire of 27-wire cable	P1
13.	P1	Space pulse coil	P2
14.	From this point the circuit is similar to that described for a normal key circuit, in P operation. (See subpar. 5102a, steps 9 thru 18.)		
6a.	Actuating leaf of FIG cam switch	9253 wire	T30
6b.	T30	Contact	S30
6c.	From this point the circuit is similar to that described for the figures key circuit, in P operation. (See subpar. 5103b, steps 5 thru 8.)		

c. *Letters Key Circuit.*—The purpose of this circuit is to shut off the shift tube (V103) and the neon glow lamp. This is done by momentarily reducing the plate voltage of tube V103 to essentially zero. Depression of the LET key accomplishes this action.

(1) In P operation, depression of the LET key switch completes a circuit through capacitors C112 and C115 and resistor R115 directly to the plate of tube V103. The circuit is as follows:

Step No.	From	Through	To
1.	C16	O wire	K44
2.	K44	O wire	K6 (Common post in keyboard)

~~CONFIDENTIAL~~

KAM-1/TSEC

3.	K6	LET key switch	K27
4.	K27	9251 wire	S40
5.	S40	9251 wire	U4
6.	U4	C112, C115, and R115 in parallel	V4
7.	V4	9651 wire	Pin 6, V103 (Plate)

(2) In E position, depressing the LET key switch accomplishes two things. First, a letter is printed which represents the enciphered version of the letters function. Secondly, shift tube V103 and the neon glow lamp, N101, are extinguished. Note that the enciphered versions of the LET key switch and V key switch are the same. The circuit is as follows:

Step No.	From	Through	To
1.	C16 (Common)	O wire	K44
2.	K44	O wire	K6 (Common post in keyboard)
3.	K6	LET key switch	K26
4.	K26	9565 wire	K40
5.	K40	Connecting bar	K41
6.	K41	9256 wire	S41
7.	S41	Contact	T41
8.	T41	9256 wire	Actuating leaf of LET cam switch
9.	Actuating leaf of LET cam switch	9235 wire	T42
10.	T42	Contact	S42
11.	S42	9235 wire	K39
12.	K39	9235 wire	K43
13.	K43	Connecting bar	VE
14.	From this point the circuit is similar to that described for a normal key circuit in E operation. (See subpar. 5102b steps 4 thru 10.)		
9a.	Actuating leaf of LET cam switch	9251 wire	T40
9b.	T40	Contact	S40
9c.	From this point the circuit is similar to that described for the letters key circuit in P operation. (See subpar. c above, steps 5 thru 7.)		

(3) During decipher operation, the shift to letters condition can be accomplished in either of two ways.

(a) The first is by depression of the LET key switch. This method, however, is not truly a deciphering function and merely serves to shift the machine to letters when

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

figures are printing and letters are desired. The circuit for this is the same as that described in subparagraph c(1) above, except that instead of being completed through terminal K27 (see subpar. c(1), Step No. 3) of the LET key switch completes a circuit to K28 and then by bus wire to K27.

- (b) The second method of shifting to letters condition is by deciphering the enciphered version of the letters function. For example, if the character S represented this enciphered version, depression of the S key switch during D operation momentarily places the plate of the shift tube at zero potential, thus shutting off the tube and neon glow lamp, N101. The circuit is as follows:

Step No.	From	Through	To
1.	The circuit follows a path similar to that described for a normal key circuit in D operation. (See subpar. 5102c, steps 1 thru 8.)		
2.	VE	Connecting bar	K42
3.	K42	Bus wire	K41
4.	K41	9256 wire	S41
5.	S41	Contact	T41
6.	T41	9256 wire	Actuating leaf of LET cam switch
7.	Actuating leaf of LET cam switch	9235 wire	T42
8.	T42	Contact	S42
9.	S42	9236 wire	K39
10.	K39	Connecting bar	K40
11.	K40	9536 wire	K25
12.	K25	Connecting bar	VP
13.	VP	One wire of 27-wire cable	PV
14.	PV	Contact	QV
15.	QV	V pulse coil	Q4
16.	Q4	Contact	P4
17.	P4	9036 wire	P1
18.	P1	Contact	Q1
19.	Q1	Space pulse coil	Q2
20.	Q2	Contact	P2
21.	From this point the circuit is similar to that described for a normal key circuit in P operation. (See subpar. 5102a, steps 9 thru 18.)		
7a.	Actuating leaf of LET cam switch	9251 wire	T40

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

7b.	T40	Contact	S40
7c.	S40	9251 wire	U4
7d.	U4	C115, C112, and R115 in parallel	V4
7e.	V4	9651 wire	Pin 6, V103 (Plate)

d. *Space Bar Circuit.*

- (1) In P operation, this circuit is the same as for any normal key circuit. Closure of the space bar completes a circuit through a T-shaped contact to terminal K32. For point-to-point circuit tracing see subparagraph 5102a, which is the circuit for a normal key circuit in P operation.
- (2) In E operation, the space bar uses the Z key circuit. The circuit for this operation is similar to that described for a normal key circuit in E operation (see subpar. 5102b). Depression of the space bar completes a circuit through the T-shaped contact to terminal ZE. Note that the spaces which are interjected after each five machine operations are the result of a mechanical function in the machine; not an electrical function.
- (3) In D operation, when the enciphered version of the space bar is deciphered, a space is printed. Since the spaces interjected after each fifth operation in E position were a mechanical function, they will have no effect in D operation. The circuit is as follows:

Step No.	From	Through	To
1.	The circuit follows a path similar to that described for a normal key circuit in D operation. (See subpar. 5102c, steps 1 thru 8.)		
2.	ZE	Connecting bar	K32
3.	K32	One wire of the 27-wire cable	P1
4.	P1	Contact	Q1
5.	Q1	Space pulse coil	Q2
6.	Q2	Contact	P2
7.	From this point the circuit is similar to that described for a normal key circuit in P operation. (See subpar. 5102a, steps 9 thru 18.)		

e. *V, J, and Z Key Circuits.*—Since the V, J, and Z key circuits are used for letter, figure, and space enciphering and deciphering functions, some circuitry must be setup to accommodate these letters during E and D operation. This is accomplished by having the J key switch use the Y key circuit, and the Z key switch use the X key circuit. The V key switch, however, does not utilize another key circuit. Its circuit is determined by the condition of shift tube V103 (see subpar. (1) below).

- (1) When in E operation, depression of either the V or LET key switch results in printing of the enciphered version of V. Whether or not a V character prints or the figures shift operates in D operation depends upon the condition of the shift tube. If the shift tube is in letters condition, the bias on the sharpener tube will be low and the low V pulse coil initiates printing. Conversely, if the shift tube is already in figures condition, the bias on the sharpener is high, and the high space pulse coil initiates printing. Thus, depression of the V key switch while in figures condition results in the same action as would happen if the LET key switch had been depressed.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

- (2) In E operation, the J key switch used the Y key circuit. (That is, from closed J key switch, through T-shaped contact, to K16. K16 via 9530 wire to K15. K15 through connecting bar to YE.) Since the enciphered version of J will always be deciphered as a Y, the letter J is never reproduced on the tape in the deciphering operation. The J key circuit in both P and E operation is similar to those described for normal key circuits (see subpar. 5102a and 5102c).
- (3) The circuit for a Y key switch in E operation is similar to any normal key circuit. It is connected from the closed Y key switch and T-shaped contact to K14, through 9530 wire to YE. From this point the circuit is completed like any normal key circuit in E operation. In P and D operation, the Y key circuit is similar to normal key circuits (see subpar. 5102a and 5102c).
- (4) In E operation, the Z key switch uses the X key circuit. (The switching is accomplished as follows: From closed Z key switch, through T-shaped contact, to K23. K23 via bus wire to K22. K22 through connecting bar to XE.) Since the enciphered version of Z will always be deciphered as X, the letter Z is never reproduced on the tape in the deciphering operation. The Z key circuit in both P and E operation is similar to the normal key circuits (see subpar. 5102a and 5102c).
- (5) The circuit for an X key switch in E operation is similar to any normal key circuit. It is connected from the closed X key switch and sliding T-shaped contact to K24, through 9565 wire to XE. From this point the circuit is completed like any normal key circuit in E operation. In P and D operation, the circuit is similar to normal key circuits (see subpar. 5102a and 5102c).

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

5200—TUBE CIRCUITS:

5201. **Tube Functions.**—The following four tubes are used in TSEC/KL-7:

- a. *Print Tube V101.*—This type 2D21 thyratron tube operates as an off-on switch that controls the printing and cycling functions of the machine.
- b. *Sharpener Tube V102.*—This 2D21 thyratron tube operates as a pulse selector and sharpener. Its cathode-follower output is connected through coupling capacitor C114 to the control grid of the print tube. Its grid input is provided from the secondary winding of transformer, T101.
- c. *Shift Tube V103.*—This type 2D21 thyratron serves as the off-on switch to determine whether the machine operates in figures or letters condition. A neon glow lamp, N101, working in conjunction with the tube, indicates when the tube conducts.
- d. *Gate Tube V104.*—A type 12AX7 dual-triode operates as a single-shot multivibrator. It is triggered by key switch closure and its square-wave output is applied to the shield grid of the print tube.

5202. **Print Tube V101.**

- a. *Plate Supply.*—The plate supply is provided through the normally closed contacts of the cam switch and the keyboard to the unisolated 200-volt supply. The circuit is as follows:

Step No.	From	Through	To
1.	Pin 6, V101 (Plate)	9136 wire	F1 and F2
2.	F1 and F2	Contact	G1 and G2
3.	G1 and G2	Print magnet winding	G3 and G4
4.	G3 and G4	Contact	F3 and F4
5.	F3 and F4	9135 wire	K3
6.	K3	Connecting bar, K5, and bus wire in P operation Connecting bar in E operation Connecting bar in D operation	K4
7.	K4	9255 wire	S12
8.	S12	Contact	T12
9.	T12	9255 wire	Bottom leaf of charge cam switch
10.	Bottom leaf of charge cam switch	Contact	Actuating leaf of charge cam switch
11.	Actuating leaf of charge cam switch	9233 wire	T11
12.	T11	Contact	S11
13.	S11	9233 wire	C8
14.	C8	Bus wire	C15
15.	C15	9233 wire	W2 (Unisolated 200-voltsupply)

~~CONFIDENTIAL~~

ORIGINAL

b. *Cathode.*—The cathode is connected directly to common. The circuit is as follows:

Step No.	From	Through	To
1.	C16 (Common)	O wire	Pin 4, V101 (Filament)
2.	Pin 4, V101	Bus wire	Pin 2, V101 (Cathode)

c. *Control-grid Input.*—The control grid input is taken from the cathode of the sharpener tube (V102) via capacitor C114 (see subpar. 5203e).

d. *Control-grid Bias.*—The control grid is connected to a point on the voltage dividing network composed of resistors R105 and R106. This network is connected between the negative 72-volt supply and common. The circuit for the voltage divider is as follows:

Step No.	From	Through	To
1.	U18 (Negative 72-volt supply)	9 wire	X12
2.	X12	9 wire	Z7
3.	Z7	9 wire	W1
4.	W1	R106	V1
5.	V1	R105	U1 (Common)

The control grid of tube V101 is connected to the voltage dividing network from terminal V1 through a 9631 wire to Pin 1 (control grid) of tube V101.

e. *Shield-grid Bias.*—The shield grid is connected to a point on the voltage dividing network composed of resistors R107, R112, and R113. This network is connected between the negative 72-volt supply and the positive side of the unisolated 200-volt supply. The voltage at the point to which the shield grid is connected is determined by the output from the gate tube, V104.

*Note:* It is possible to effectively connect the shield grid directly to common rather than the voltage dividing network by depressing the RPT key. (See subpar. 5103a.)

The circuit for the voltage dividing network is as follows:

Step No.	From	Through	To
1.	Negative 72-volt supply	9 wire	W1
2.	W1	R107	X1
3.	X1	9636 wire	U3
4.	U3	R112	V3
5.	V3	R113	W3
6.	W3	9500 wire	S21
7.	S21	Contact	T21

~~CONFIDENTIAL~~

KAM-1/TSEC

8.	T21	9 wire	Actuating leaf of RPT cam switch
9.	Actuating leaf of RPT cam switch	9031 wire	T22
10.	T22	Contact	S22
11.	S22	Bus wire	S11
12.	S11	9233 wire	C8 (Unisolated 200-volt supply)
13.	C8	Bus wire	C15

The shield grid of tube V101 is connected to the voltage dividing network from terminal U3 through a 9636 wire to pin 5 (shield grid) of tube V101.

f. *Print Capacitor Discharge Circuit.*—When V101 fires, capacitors C101 and C102 will discharge, thereby energizing the print magnet. The circuit is as follows:

Step No.	From	Through	To
1.	C101 and C102	Connections	C9 and C16 (Common)
2.	C9 and C16	0 wire	Pin 4, V101
3.	Pin 4, V101	Bus wire	Pin 2, V101 (Cathode)
4.	Pin 2, V101	Conducting tube V101	Pin 6, V101 (Plate)
5.	Pin 6, V101	9136 wire	F1 and F2
6.	F1 and F2	Contacts	G1 and G2
7.	G1 and G2	Print magnet winding	G3 and G4
8.	G3 and G4	Contacts	F3 and F4
9.	F3 and F4	9135 wire	K3
10.	K3	Keyboard (see subpar. 5202a, Step No. 6)	K4
11.	K4	9255 wire	S12
12.	S12	Contact	T12
13.	T12	9255 wire	Normally closed charge cam switch
14.	Normally closed charge cam switch	9283 wire	T11
15.	T11	Contact	S11
16.	S11	9233 wire	C8 and C15
17.	C8 and C15	Connection	C101 and C102

~~CONFIDENTIAL~~

ORIGINAL

g. *Trip Capacitor Discharge Circuit.*—When tube V101 fires, capacitors C106 and C107 discharge. The pulse from this discharge energizes the trip magnet. The circuit is as follows:

Step No.	From	Through	To
1.	C106 and C107	Connection	Z5 and Z6
2.	Z5 and Z6	9131 wire	A1
3.	A1	9131 wire	S50
4.	S50	Contact	T50
5.	T50	6 wire and trip magnet winding	T52
6.	T52	Contact	S52
7.	S52	0 wire	C9 and C16 (Common)
8.	From this point the circuit is similar to that described for the discharge of print capacitor C101 and C102. (See subpar. f above, steps 2 thru 17.)		
9.	C8 and C15	9233 wire	W2 (Unisolated 200-volt supply)
10.	W2	9233 wire	X7 and X8
11.	X7 and X8	Connection	C106 and C107

h. *Recharge Circuit for Print and Trip Capacitors.*—The actuating leaf of the charge cam switch, normally made to one side of the print magnet winding, breaks from this point to make with a point that will short out resistor R110 from the recharge path of print and trip capacitors. The circuit traced from one side of the full-wave rectifier to the other is as follows:

Step No.	From	Through	To
1.	W11 (Negative side of full-wave rectifier)	0 wire	Y7
2.	Y7	0 wire	Z10
3.	Z10	0 wire	Z3
4.	Z3	0 wire	Pin 3, V104 (Cathode)
5.	Pin 3, V104	0 wire	U1
6.	U1	0 wire	Pin 2, V101 (Cathode)
7.	Pin 2, V101	Bus wire	Pin 4, V101 (Filament)
8.	Pin 4, V101	0 wire	C16 and C9
9.	C16 and C9	0 wire	S52
10.	S52	Contact	T52
11.	T52	6 wire and trip magnet winding.	T50
12.	T50	Contact	S50

~~CONFIDENTIAL~~

KAM-1/TSEC

13.	S50	9131 wire	A1
14.	A1	9131 wire	Z5 and Z6
15.	Z5 and Z6	C106 and C107	X7 and X8
16.	X7 and X8	9233 wire	W2 (Unisolated 200-volt supply)
17.	W2	9233 wire	C8 and C15
9a.	C16 and C9	C101 and C102	C8 and C15
9b.	C8 and C15	9233 wire	S11
9c.	S11	Contact	T11
9d.	T11	9233 wire	Actuating leaf of charge cam switch
9e.	Actuating leaf of charge cam switch	9232 wire	T10
9f.	T10	Contact	S10
9g.	S10	9232 wire	V2
9h.	V2	R109	U2
9i.	U2	9 wire	W8 (Positive side of full-wave rectifier)

i. *Momentary Space Switch.*—When the selector handle is moved from P to E position, two terminals in the keyboard are shorted together momentarily through a connecting bar. This permits the trip capacitors C106 and C107 to discharge. The circuit is as follows:

Step No.	From	Through	To
1.	C106 and C107	Connection	Z5 and Z6
2.	Z5 and Z6	9131 wire	A1
3.	A1	9131 wire	S50
4.	S50	Contact	T50
5.	T50	6 wire and trip magnet winding	T52
6.	T52	Contact	S52
7.	S52	0 wire	C9 and C16 (Common)
8.	C9 and C16	Common circuit	Y7
9.	Y7	R129	Z9
10.	Z9	9633 wire	K21
11.	K21	Connecting bar (When selector handle is between P and E position)	K20
12.	K20	9233 wire	S22

~~CONFIDENTIAL~~



13.	S22	Bus wire	S11
14.	S11	9233 wire	C8 and C15
15.	C8 and C15	9233 wire	W2 (Unisolated 200-volt supply)
16.	W2	9233 wire	X7 and X8
17.	X7 and X8	Connection	C106 and C107

**5203. Sharpener Tube V102.**

a. *Plate Supply.*—The plate supply for tube V102 is connected through voltage dropping resistor R111 to the unisolated 200-volt supply. The circuit is as follows:

Step No.	From	Through	To
1.	Pin 6, V102 (Plate)	9652 wire	X2
2.	X2	R111	W2 (Unisolated 200-volt supply)

b. *Bias Supply.*—The cathode of tube V102 is wired through resistor R120 to a point on the voltage dividing network composed of resistors R122, R121, and R119. The following chart traces the circuit from this point on the voltage divider to the cathode of tube V102:

Step No.	From	Through	To
1.	W5 (Point on voltage dividing network)	R120	X5
2.	X5	9685 wire	Pin 2, V102 (Cathode)

The following chart traces the circuit for the voltage dividing network:

Step No.	From	Through	To
1.	Common	0 wire	W6
2.	W6	R122	V6
3.	V6	R121	U6
4.	U6	9 wire	W5
5.	W5	R119	V5 (Isolated 220-volt supply)

c. *Capacitor C113 Discharge Circuit.*—When tube V102 conducts, capacitor C113 discharges through the tube. The discharge of this capacitor decreases the plate voltage to such an extent that the thyratron tube shuts off. In addition to shutting off the tube, the discharge

of capacitor C113 serves to sharpen the positive spike at the cathode of tube V102. The circuit is as follows:

Step No.	From	Through	To
1.	C113	Connection	W5
2.	W5	R120	X5
3.	X5	9635 wire	Pin 2, V102 (Cathode)
4.	Pin 2, V102	Conducting tube	Pin 6, V102 (Plate)
5.	Pin 6, V102	9652 wire	X2
6.	X2	Connection	C113

d. *Control Grid Input.*—The input of tube V102 is provided from the secondary of transformer T101. The circuit is as follows:

Step No.	From	Through	To
1.	Secondary winding, T101	Connection	C6
2.	C6	9132 wire	Pin 1 and 5, V102 (Control grid)

e. *Cathode Follower Output.*—The output of the sharpener tube (V102) is taken from its cathode and coupled to the control grid of the print tube (V101) by means of capacitor C114. The circuit is as follows:

Step No.	From	Through	To
1.	Pin 2, V102 (Cathode)	9635 wire	X5
2.	X5	C114	V1
3.	V1	9631 wire	Pin 1, V101 (Control grid)

**5204. Shift Tube V103.**—The purpose of the shift tube is to determine whether the machine is to print letters or figures. In E operation, the condition of the machine is only indicated. In P and D operation, however, the condition is actually *effected* by the shift tube varying the bias on the sharpener tube.

*Note:* The discussion outlined below is concerned only with the figures (on) condition of tube V103. For discussions concerning the *selection* of the on or off condition, i. e., the figures or letters shift, see subparagraphs 5103b and 5103c.

a. *P and D Operation.*—When conducting in either the P or D position, the shift tube is connected in parallel with a section of the voltage dividing network composed of resistors R122, R121, and R119. The circuit is as follows:

Step No.	From	Through	To
1.	Common	0 wire	W6
2.	W6	R122	V6

3.	V6	9650 wire	K36
4.	K36	Connecting bar and C120 in parallel in P operation Connecting bar, K37 and bus wire in parallel with C120 in D operation	K35
5.	K35	9133 wire	J2
6.	J2	R130 and N101 in parallel	J1
7.	J1	9150 wire	C18
8.	C18	9150 wire	Pins 5 and 2, V103 (Cathode)
9.	Pins 5 and 2, V103	Conducting tube	Pin 6, V103 (Plate)
10.	Pin 6, V103	9651 wire	V4
11.	V4	R116	W4 (Isolated 220-volt supply)

b. *E Operation.*—The shift tube is *not* connected in parallel with any section of the voltage dividing network composed of resistors R122, R121, and R119 in E operation. Instead, the circuit through this tube is completed between common and the isolated 220-volt supply. The condition of the machine is indicated through the neon glow lamp, N101. The circuit is as follows:

Step No.	From	Through	To
1.	Common	0 wire	K44
2.	K44	R133	K38
3.	K38	Connecting bar	K37
4.	K37	Bus wire	K35
5.	K35	9133 wire	J2
6.	From this point the circuit is similar to that described for tube V103 in P or D operation. (See subpar. a above, steps 6 thru 11.)		

5205. *Gate Tube V104.*—Gate tube V104 is a single-shot multivibrator with the A section of the tube normally conducting. The B section of the tube is cut off until a certain sequence of events has taken place.

a. *Plate Supply for Sections A and B.*

(1) The plate supply for the A section of the tube is connected through resistor R113 to the unisolated 200-volt supply. The circuit is as follows:

Step No.	From	Through	To
1.	Pin 1, V104 (Plate)	9656 wire	V3
2.	V3	R113	W3
3.	From this point the circuit is similar to that described for the shield grid bias for the print tube. (See subpar. 5202a, steps 6 thru 13.)		

~~CONFIDENTIAL~~

KAM-1/TSEC

(2) The plate supply for the B section of the tube is provided by the isolated 220-volt supply through resistor R117. The circuit is as follows:

Step No.	From	Through	To
1.	Pin 6, V104 (Plate)	9655 wire	Y1
2.	Y1	9655 wire	X4
3.	X4	R117	W4 (Isolated 220-volt supply)

b. *Cathode Supplies for A and B Sections.*—The cathode of tube V104A (pin 3) is connected directly to common at point U1. The cathode of the B section of the tube is connected to common through resistor R126. The circuit is as follows:

Step No.	From	Through	To
1.	C16	Common	Y6
2.	Y6	R126	X10
3.	X10	9031 wire	Z4
4.	Z4	9031 wire	Pin 8, V104 (Cathode)

c. *Grid Circuit of B Section of Tube V104.*—The control grid (pin 7) of the B section of the tube is connected to a point on a voltage dividing network composed of resistors R125, R124, and R113. This network is connected between the negative 72-volt supply and the unisolated 200-volt supply. The point to which the control grid is connected is normally of such potential as to prevent the B section of the tube from conducting. The following chart traces the circuit for the voltage divider:

Step No.	From	Through	To
1.	Z7 (Negative 72-volt supply)	R125	Y5
2.	Y5	R124	X9
3.	X9	9656 wire	V3
4.	V3	R113	W3
5.	From this point the circuit is similar to that described for the shield grid bias for the print tube. (See subpar. 5202e, steps 6 thru 18.)		

The grid of the B section of tube V104, pin 7, is connected directly to terminal Y5 on the voltage divider through a 9632 wire.

d. *Grid Circuit of A Section of Tube V104.*

(1) Sufficient bias to cut off the A section of tube V104 results when capacitor C117 dis-

~~CONFIDENTIAL~~

charges. Discharge of this capacitor is caused by the single-shot multivibrator action of the tube. The basic discharge circuit is as follows:

Step No.	From	Through	To
1.	C117	Connection	Z1
2.	Z1	9653 wire	X6
3.	X6	R123	W6
4.	W6	Common circuit	Y6
5.	Y6	R126	X10
6.	X10	9031 wire	Z4
7.	Z4	9031 wire	Pin 8, V104 (Cathode)
8.	Pin 8, V104	Conducting B section of tube	Pin 6, V104 (Plate)
9.	Pin 6, V104	9655 wire	Y1
10.	Y1	Connection	C117

(2) The grid of the A section of the tube is connected to the discharge path of C117 as follows:

Step No.	From	Through	To
1.	X6 (Point on discharge path of C117)	9653 wire	Z1
2.	Z1	9653 wire	Pin 2, V104 (Grid)

e. *Discharge of Capacitor C105.*—At key closure, capacitor C105 discharges through resistors R131 and R126 with the voltage drop across R126 causing the cathode of the B section to become negative with respect to its grid. This allows the B section of tube V104 to conduct. The discharge circuit of capacitor C105 is as follows:

Step No.	From	Through	To
1.	C105	Connection	Z4
2.	Z4	9031 wire	X10
3.	X10	R126	Y6
4.	Y6	Common circuit	K6 (Common in keyboard)
5.	K6	Closed key circuit and associated pulse generator coil	V14
6.	V14	Bus wire	V15
7.	V15	R131	U15

~~CONFIDENTIAL~~

KAM-1/TSEC

8.	U15	9201 wire	X3
9.	X3	Bus wire	Y4
10.	Y4	Connection	C105

~~CONFIDENTIAL~~

ORIGINAL

5300—POWER CIRCUITS

5301. General.—The power circuits of TSEC/KL-7 are as follows:

- a. *Input Circuit.*—The 24-volt DC power which is required to operate the TSEC/KL-7 cipher machine is fed through the power cable (fig. 1) and two fuses (one in each side of the line) to contacts K1 and K2 in the keyboard assembly. From this point the power is fed through contacts of the sliding contact board assembly (which acts as a power on-off switch) to the operator's light, the motor, and tube filaments. External power is to be applied so that positive power polarity is connected to pin A of the power cable plug, while negative power polarity is connected to pin B.
- b. *Motor-Generator and Controller Unit.*—The DC input voltage from the external power source is connected to the motor through a controller unit which governs the speed of the motor. The motor drives two generators, one of which supplies the pulses that initiate the printing action, while the other generates the AC voltage which, after rectification, provides plate and bias voltages for the electron tubes.
- c. *Full-Wave Rectifier.*—The 400-cycle, 150- 180-volt output of the AC generator, is fed into a bridge-type full-wave rectifier, the output of which provides the required DC plate supply and bias voltages. The bridge rectifier is composed of 12 germanium type diodes.
- d. *Unisolated 200-volt Supply.*—The unisolated 200-volt supply is connected directly to the full-wave rectifier. This is the plate voltage source for tubes V101, V102, and V104A.
- e. *Isolated 220-volt Supply.*—This supply is isolated from the full-wave rectifier by diodes D103 and D104. Its output supplies plate voltage for V103 and V104B.
- f. *Negative 72-volt Supply.*—A half-wave rectifier, in conjunction with a filter network, provides an output that is 72-volts negative with respect to common. This voltage supply is used for biasing purposes.
- g. *Tube Filaments.*—The tube filaments are supplied directly from the external power source. Shunt resistors control the amount of current through each filament as required.

5302. Input Circuit.—The negative side of the power input circuit is as follows:

Step No.	From	Through	To
1.	Pin B of power plug	Cable and fuse	K2
2.	K2	0 wire	A2
3.	A2	0 wire	C16 (Common)
2a.	K2	0 wire	L2 (Operator's light)

The positive side of the power input circuit is as follows:

Step No.	From	Through	To
1.	Pin A of power plug	Cable and fuse	K1
2.	K1	2 wire	K12
3.	K12	2 wire	C1 (Positive)
2a.	K1	2 wire	L1 (Operator's light)

~~CONFIDENTIAL~~

KAM-1/TSEC

**5303. Motor-Generator and Controller Circuit.**—The input from the external power source operates the motor through the controller box. Adjustable resistor R202 and negative coefficient resistor R201 in the controller box regulate the speed of the motor. These resistors are in series with the motor field. The circuit is as follows:

Step No.	From	Through	To
1.	Pin B (Negative) of input plug	Fuse	Leaf spring ( in keyboard)
2.	Leaf spring	Contact	K2
3.	K2	0 wire	A2
4.	A2	0 wire	C16 (Common)
5.	C16	Bus wire	C9
6.	C9	0 wire	S52
7.	S52	0 wire	M2
8.	M2	Contact	N2
9.	N2	Resistor R201, R202, and motor field	N1
9a.	N2	Motor armature	N1
10.	N1	Contact	M1
11.	M1	Bus wire	C1
12.	C1	2 wire	K12
13.	K12	2 wire	K1
14.	K1	Contact	Leaf spring (in keyboard)
15.	Leaf spring	Fuse	Pin A (Positive) of input plug

**5304. Full-Wave Rectifier Circuit.**—The bridge-type full-wave rectifier converts the output of the 400-cycle AC generator to steady DC to meet the plate and bias voltage requirements of the machine. Assuming terminal N3 to be negative, the circuit is as follows:

Step No.	From	Through	To
1.	N3 (Negative side of generator output)	Contact	M3
2.	M3	9281 wire	U12
3.	U12	D111	V12
4.	V12	D112	W12
5.	W12	D117	W11 (Negative leg of full-wave rectifier)

~~CONFIDENTIAL~~

ORIGINAL



~~CONFIDENTIAL~~

KAM-1/TSEC

6.	W11	Associated load circuits	W8 (Positive leg of full-wave rectifier)
7.	W8	D118	W10
8.	W10	D108	V10
9.	V10	D107	U10
10.	U10	9252 wire	M4
11.	M4	Contact	N4 (Positive side of generator output)

When terminal N4 is negative, the circuit is as follows:

Step No.	From	Through	To
1.	N4 (Negative side of generator)	Contact	M4
2.	M4	9252 wire	U10
3.	U10	D119	U11
4.	U11	D109	V11
5.	V11	D110	W11 (Negative leg of full-wave rectifier)
6.	W11	Associated load circuits	W8 (Positive leg of full-wave rectifier)
7.	W8	Bus wire	W9 (Rectifier)
8.	W9	D106	V9
9.	V9	D105	U9
10.	U9	D119	U12
11.	U12	9231 wire	M3
12.	M3	Contact	N3 (Positive side of generator field)

**5305. Unisolated 200-Volt Supply.**—The unisolated 200-volt supply is obtained from the full-wave rectifier, through resistors R109 and R110. It provides plate voltage for tubes V101, V102, and V104A. The circuit is as follows:

Step No.	From	Through	To
1.	W8 (Positive terminal of full-wave rectifier)	9 wire	U2
2.	U2	R109	V2
3.	V2	R110	W2

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

4.	W2	9233 wire	C15 and C8
5.	C15 and C8	9233 wire	S11
6.	S11	Bus wire	S22

**5306. Isolated 220-Volt Supply.**—The purpose of the isolated 220-volt supply is to prevent heavy voltage drops on the plates of tubes V101 and V102 from affecting the operation of tubes V103 and V104B. The circuit is as follows:

Step No.	From	Through	To
1.	W8 (Positive terminal of full-wave rectifier)	D104	V8
2.	V8	D103	U8
3.	U8	9 wire	V5
4.	V5	9 wire	W4
5.	W4	9 wire	Y3
6.	Y3	9 wire	X13
5a.	W4	R114	X3
5b.	X3	9 wire	U15
5c.	U15	R131	V15
5d.	V15	Bus wire	V14
5e.	V14	9031 wire	P2

**5307. Negative 72-Volt Bias Supply.**—This supply, which is a half-wave rectifier connected across half the output of the 400-cycle AC generator (through half of the full-wave rectifier and capacitor C103), provides negative bias for tubes V101, V103, and V104B. The half-wave rectifier circuit is as follows:

Step No.	From	Through	To
1.	W11 (Positive of bias supply)	0 wire	Y7
2.	Y7	R128	X11
3.	X11	D116	W13
4.	W13	D114	V13
5.	V13	D113	U13
6.	U13	9 wire	X12
7.	X12	9 wire	Z7
8.	Z7	9 wire	W1 (Negative of bias supply)

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

5308. **Common Circuit.**—One side of the key, pulse generator, and power supply circuits is connected to a common return circuit which, beginning with the negative power input terminal, K2, includes the following terminals:

A2	W6
C9	W11
C13	Y6
C14	Y7
C16	Z3
K6	Z10
K44	Z11
M2	2 of V101
S52	4 of V101
U1	3 of V104

5309. **Tube Filament Circuit.**—The tube filament circuit, together with the shunt resistors which are used to limit filament current as necessary, is as follows:

Step No.	From	Through	To
1.	C16 (Common negative)	0 wire	Pin 4, V101
2.	Pin 4, V101	Filament	Pin 3, V101
3.	Pin 3, V101	9153 wire	Pin 4, V102
4.	Pin 4, V102	Filament	Pin 3, V102
5.	Pin 3, V102	9 wire	Pin 4, V103
6.	Pin 4, V103	Filament	Pin 3, V103
7.	Pin 3, V103	20 wire	Pin 9, V104
8.	Pin 9, V104	Paralleled filaments	Pins 4 and 5, V104
9.	Pins 4 and 5, V104	2 wire	M1
10.	M1	2 wire	C1 (Positive input)
3a.	Pin 3, V101	9153 wire	C10
3b.	C10	R102	C3
3c.	C3	Bus wire	C2
3d.	C2	R101	C1 (Positive input)
7a.	Pin 3, V103	20 wire	C2

5310. **AC Power Converter.**—The primary (AC input) circuit of the CE 87066 AC power converter, arranged for 100- 125-volt operation, may be traced with the aid of the schematic wiring diagram (fig. 64) or the actual wiring diagram (fig. 65) as follows:

Step No.	From	Through	To
1.	AC input	White wire	Terminal 4
2.	Terminal 4	White wire	Terminal 15

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

3.	Terminal 15	Connecting bar	Terminal 14
4.	Terminal 14	Black wire	Terminal 11
5.	Terminal 11	Blue wire	Terminal 2
6.	Terminal 2	Winding	Terminal 1
7.	Terminal 1	Black wire	Terminal 16
8.	Terminal 16	Fuse	Terminal 17
9.	Terminal 17	Black wire	Other side of AC input
2a.	Terminal 4	Winding	Terminal 3
2b.	Terminal 3	Green wire	Terminal 12
2c.	Terminal 12	Connecting bar	Terminal 13
2d.	Terminal 13	Black wire	Terminal 1
2e.	Remainder of circuit is the same as steps 7 and 8 above.		

Arranged for 200- 250-volt operation, the primary circuit is traced as follows:

Step No.	From	Through	To
1.	AC input	White wire	Terminal 4
2.	Terminal 4	Winding	Terminal 3
3.	Terminal 3	Green wire	Terminal 12
4.	Terminal 12	Connecting bar	Terminal 11
5.	Terminal 11	Blue wire	Terminal 2
6.	Terminal 2.	Winding	Terminal 1
7.	Terminal 1	Black wire	Terminal 16
8.	Terminal 16	Fuse	Terminal 17
9.	Terminal 17	Black wire	Other side of AC input

The secondary (DC output) circuit is the same regardless of the input voltage value, and is as follows:

Step No.	From	Through	To
1.	Terminal 5	Yellow wires	Terminals 7(a) and 7(b)
2.	7(a) and 7(b)	Rectifiers	Terminals 9(a) and 9(b)
3.	9(a) and 9(b)	Black wires	Pin B of output plug
4.	Pin B of output plug	TSEC/KL-7 power circuits	Pin A of output plug
5.	Pin A of output plug	White wire	Terminal 10(b)

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

6.	Terminal 10(b)	Red wire	Terminal 10(a)
7.	10(a) and 10(b)	Rectifiers	Terminals 9(a) and 9(b)
8.	9(a) and 9(b)	Yellow wires	Terminal 6

~~CONFIDENTIAL~~

ORIGINAL

5400—ROTOR STEPPING CIRCUIT

5401. General (fig. 62 and 63).—Each of the seven movable rotors in the stepping unit is controlled by a stepping magnet. When a stepping magnet is energized, its associated rotor steps one position. The magnets may be energized in the P, E, and D positions. In P position, each magnet is directly controlled by a set key, and depression of a set key causes the associated stepping magnet to energize. In E and D positions, the magnets are energized through switches that are actuated by notched rings on the rotors themselves. The circuit is designed so that at least three rotors step for each machine operation in E or D position.

5402. Fixed Connections.—Fixed connections to the actuator switch leaf springs and the common circuit for the stepping unit are provided through terminals on the stepping unit contact block. These connections are as follows:

a. Trip Magnet Circuit, B1.—In P operation, it is possible to close a positive potential to common through the trip magnet winding. Thus it is possible to trip the timing shaft without depressing a key switch. This potential, as applied to each of the actuator switches is as follows:

Step No.	From	Through	To
1.	C9 (Common)	0 wire	S52
2.	S52	Contact	T52
3.	T52	6 wire and trip magnet	T50
4.	T50	Contact	S50
5.	S50	9131 wire	A1
6.	A1	9131 wire	B1
7.	B1	9131 wire	1 of S301
8.	1 of S301	Bus wire	1 of S302
9.	1 of S302	Bus wire	1 of S303
10.	1 of S303	9131 wire	1 of S304
11.	1 of S304	Bus wire	1 of S305
12.	1 of S305	Bus wire	1 of S306
13.	1 of S306	Bus wire	1 of S307

b. Common Circuit, B2.—One side of each of the rotor stepping magnets is connected to common as follows:

Step No.	From	Through	To
1.	K2 (Negative input—common)	0 wire	A2
2.	A2	Contact	B2
3.	B2	0 wire	1 of L301

~~CONFIDENTIAL~~

KAM-1/TSEC

4.	1 of L301	Bus wire	1 of L302
5.	1 of L302	Bus wire	1 of L303
6.	1 of L303	0 wire	1 of L304
7.	1 of L304	Bus wire	1 of L305
8.	1 of L305	Bus wire	1 of L306
9.	1 of L306	Bus wire	1 of L307

c. *24-Volt Supply, E and D Operation, B3.*—A positive source of 24 volts is applied to the actuator switches in E and D operation through terminal B3 on the stepping unit contact block. The circuit is as follows:

Step No.	From	Through	To
1.	6 of S306	Bus wire	6 of S305
2.	6 of S305	9152 wire	6 of S303
3.	6 of S303	Bus wire	6 of S302
4.	6 of S302	Bus wire	6 of S301
5.	6 of S301	9152 wire	B3
6.	B3	Contact	A8
7.	A8	9152 wire	K11
8.	K11	Connecting bar	K12 in E operation, or K10 in D operation
9.	K12 or K10	2 wire	K1
10.	K1	Contact	Leaf spring
11.	Leaf spring	Fuse	A of power input receptable (positive input)

d. *24-Volt Supply, P Operation, B4.*—A positive source of 24 volts is applied to the actuator switches in P operation through terminal B4 on the stepping unit contact block. The circuit is as follows:

Step No.	From	Through	To
1.	4 of S307	Bus wire	4 of S306
2.	4 of S306	Bus wire	4 of S305
3.	4 of S305	Bus wire	4 of S304
4.	4 of S304	9156 wire	4 of S303
5.	4 of S303	Bus wire	4 of S302
6.	4 of S302	Bus wire	4 of S301

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

7.	4 of S301	9156 wire	B4
8.	B4	Contact	A4
9.	A4	9156 wire	K13
10.	K13	Connecting bar	K12
11.	K12	2 wire	K1
12.	K1	Contact	Leaf spring
13.	Leaf spring	Fuse	A of power input receptacle (positive input)

**5403. Reentry Circuits.**—Ten terminals on each side of the rotor stepping unit serve as reentry circuits for character pulses passing through the cipher unit. Thus, it is possible for one character pulse to pass through the cipher unit 11 times before completing its circuit through the unit. The wiring of the reentry circuit is direct, i. e., terminal #1 on one side of the unit is tied directly to terminal #1 on the other side. The wiring code is as follows:

Terminal No.	Wire Color	Terminal No.	Wire Color
1.	9231	6.	9252
2.	9236	7.	9251
3.	9233	8.	9256
4.	9235	9.	9253
5.	9250	10.	9255

**5404. Actuator Switches.**—There are seven actuator switches in the rotor stepping unit, numbered S301 through S307. All except S304 and S307 have seven leaf assemblies. S304 and S307 have but six leaf assemblies. By making and breaking these leaf assemblies to and from the fixed potentials as applied through the contact block, different rotor stepping magnets and the trip magnet can be energized. Leaves from individual actuator switches are connected into circuits as follows:

*Note:* The following charts trace only connections and not necessarily current flow.

a. *Actuator Switch S301.*

Leaf Assembly No.	Through	To
1.	B1 and trip magnet (see subpar. 5402a)	Common
2.	9000 wire	2 of L301
3.	5 wire	3 of S305
4.	B4 and keyboard (see subpar. 5402d)	A of power input receptacle
5.	3 wire	7 of S307
6.	B3 and keyboard (see subpar. 5402c)	A of power input receptacle
7.	Bus wire	3 of S303

~~CONFIDENTIAL~~

ORIGINAL.



b. Actuator Switch S302.

Leaf Assembly No.	Through	To
1.	B1 and trip magnet (see subpar. 5402a)	Common
2.	9002 wire	2 of L302
3.	Bus wire	5 of S303
4.	B4 and keyboard (see subpar. 5402d)	A of power input receptacle
5.	2 wire	7 of S305
6.	B3 and keyboard (see subpar. 5402c)	A of power input receptacle
7.	Bus wire	7 of S303

c. Actuator Switch S303.

Leaf Assembly No.	Through	To
1.	B1 and trip magnet (see subpar. 5402a)	Common
2.	9001 wire	2 of L303
3.	1 wire Bus wire	5 of S305 7 of S301
4.	B4 and keyboard (see subpar. 5402d)	A of power input receptacle
5.	0 wire Bus wire	3 of S306 3 of S302
6.	B3 and keyboard (see subpar. 5402c)	A of power input receptacle
7.	6 wire Bus wire	6 of S304 7 of S302

d. Actuator Switch S304.

Leaf Assembly No.	Through	To
1.	B1 and trip magnet (see subpar. 5402a)	Common
2.	9006 wire	2 of L304
4.	B4 and keyboard (see subpar. 5402d)	A of power input receptacle
5.	Bus wire	6 of S304
6.	Bus wire Bus wire 6 wire	5 of S304 6 of S307 7 of S303
7.	Bus wire	5 of S307

Note: Actuator switch S304 has no leaf assembly numbered 3.

~~CONFIDENTIAL~~

e. Actuator Switch S305.

Leaf Assembly No.	Through	To
1.	B1 and trip magnet (see subpar. 5402a)	Common
2.	9003 wire	2 of L305
3.	5 wire Bus wire	3 of S301 5 of S306
4.	B4 and keyboard (see subpar. 5402d)	A of power input receptacle
5.	1 wire	3 of S303
6.	B3 and keyboard (see subpar. 5402c)	A of power input receptacle
7.	Bus wire 2 wire	7 of S306 5 of S302

f. Actuator Switch S306.

Leaf Assembly No.	Through	To
1.	B1 and trip magnet (see subpar. 5402a)	Common
2.	9005 wire	2 of L306
3.	0 wire	5 of S303
4.	B4 and keyboard (see subpar. 5402d)	A of power input receptacle
5.	Bus wire	3 of S305
6.	B3 and keyboard (see subpar. 5402c)	A of power input receptacle
7.	Bus wire	7 of S305

g. Actuator Switch S307.

Leaf Assembly No.	Through	To
1.	B1 and trip magnet (see subpar. 5402a)	Common
2.	9020 wire	2 of L307
4.	B4 and keyboard (see subpar. 5402d)	A of power input receptacle
5.	Bus wire	7 of S304
6.	Bus wire	6 of S304
7.	3 wire	5 of S301

Note: Actuator switch S307 has no leaf assembly numbered 3.

~~CONFIDENTIAL~~

5500—CIRCUIT DATA

5501. Tables.—The following tables list, identify, locate, and describe the general function of the components associated with the electronic circuits.

TABLE 1—CAPACITORS

Symbol	Value*	Part No.	Location		Function
			From	To	
C101	2	CE 11985	C8	C9	Print storage
C102	2	CE 11985	C15	C16	Print storage
C103	0.25	CE 11987	Y2	Z2	DC blocking
C104	0.25	CE 11987	Y3	Z3	Isolated 220-volt supply filter
C105	0.03	CE 87239	Y4	Z4	V104B signal coupling
C106	1	CE 11986	X7	Z5	Trip storage
C107	1	CE 11986	X8	Z6	Trip storage
C108	1	CE 11986	X12	Z10	Negative bias supply filter
C109	0.05	CE 88124	S60	C9	Trip magnet dampening
C110					No capacitor identified as C110
C111	0.001	CE 11988	C11	C18	Stray pickup filter
C112	0.01**	CE 11991	U4	V4	Letter shift signal storage
C113	0.005***	CE 11990	X2	W5	V102 cutoff
C114	0.002	CE 11989	X5	V1	V101 control-grid coupling
C115	0.01**	CE 11991	U4	V4	Letter shift signal storage
C116	0.005***	CE 11990	X1	X3	V104 gate delay
C117	0.05	CE 87279	Y1	Z1	V104B plate to V104A grid coupling
C118	0.001	CE 11988	X6	X9	V104A grid to plate coupling
C119	1	CE 11986	X13	Z11	Isolated 220-volt supply filter
C120	0.01**	CE 11991	K35	K36	Cathode coupling
C121	0.00068	CE 88037			Motor-generator/spark suppressor
C122	0.01**	CE 11991	U1	U6	
C123	0.03	CE 87239	K6	K28	

\*ALL VALUES IN MICROFARADS; ALL TOLERANCES (EXCEPT THOSE DESIGNATED) PLUS OR MINUS 10 PERCENT

\*\*PLUS 80 PERCENT; MINUS 20 PERCENT

\*\*\*PLUS OR MINUS 20 PERCENT

TABLE 2—RESISTORS

Symbol	Value*	Part No.	Location		Function
			From	To	
R101	20	RW29G200	C1	C2	V104 filament shunt
R102	330	RC30BF331K	C3	C10	V102 and V103 filament shunt
R103	100K	RC20BF104K	C4	C11	V103 control grid bias developing
R104	100K	RC20BF104K	C5	C12	V103 control grid bias developing
R105	100K**	RC20BF104J	U1	V1	V101 control grid bias developing
R106	150K	RC20BF154K	V1	W1	V101 control grid bias developing
R107	820K**	RC20BF824J	W1	X1	V101 shield grid bias developing
R108					No resistor identified as R108
R109	1K	RC20BF102K	U2	V2	Plate voltage dropping
R110	10K	RC20BF103K	V2	W2	Plate voltage dropping
R111	2.2 MEG	RC20BF225K	W2	X2	V102 plate load
R112	1.0 MEG**	RC20BF105J	U3	V3	V101 shield grid bias developing
R113	470K**	RC20BF474J	V3	W3	V104A plate load

~~CONFIDENTIAL~~

KAM-1/TSEC

R114	390K**	RC20BF394J	W4	X3	V104B signal developing
R115	560K	RC20BF564K	U4	V5	V103 plate capacitor shunting
R116	27K	RC20BF273K	V4	W4	V103 plate load
R117	1.0 MEG**	RC20BF105J	W4	X4	V104B plate load
R118	1.5 MEG	RC20BF155K	U5	V5	V103 control grid bias developing
R119	1.0 MEG**	RC20BF105J	V5	W5	V102 cathode bias developing
R120	2.7K	RC20BF272K	W5	X5	V102 cathode load
R121	27K**	RC20BF273J	U6	V6	V102 cathode bias developing
R122	3.9K**	RC20BF392J	V6	W6	V102 cathode bias developing
R123	150K**	RC20BF154J	W6	X6	V104A control grid bias developing
R124	1.0 MEG**	RC20BF105J	X9	Y5	V104B control grid bias developing
R125	1.1 MEG**	RC20BF115J	Y5	Z7	V104B control grid bias developing
R126	56K**	RC20BF563J	X10	Y6	V104B cathode load
R127	470K	RC20BF474K	Y6	Z8	Print and trip capacitor bleeder
R128	27K**	RC20BF273J	X11	Y7	Negative bias supply
R129	430	RC20BF431K	Y7	Z9	Automatic space switch
R130	100K	RC20BF104K	J1	J2	Neon glow lamp shunt
R131	180K**	RC20BF184J	U15	V15	Isolated 220-volt supply bleeder
R132	1.5 MEG	RC20BF155K	V103-1	V103 Center Post	V103 grid current limiter
R133	10K	RC20BF103K	K38	K44	V103 cathode bias
R134	27K**	RC20BF273J	W5	U6	
R135	100	CE 88086	Motor-generator		Governor current limiter
R136	31	CE 88040	Motor-generator		Field current limiter

\*ALL VALUES IN OHMS EXCEPT: MEG = megohms, and K = kilohms.  
 \*\*TOLERANCE PLUS OR MINUS 5 PERCENT. ALL OTHERS PLUS OR MINUS 10 PERCENT.  
 \*\*\*30 OHMS AT 25 DEGREES CENTIGRADE.

TABLE 3—DIODES\*

Symbol	Location		Function	Symbol	Location		Function
	From	To			From	To	
D101	U7	V7	DC blocking	D111	U12	V12	Full-wave rectifier
D102	V7	W7	DC blocking	D112	V12	W12	Full-wave rectifier
D103	U8	V8	220-volt isolation	D113	U13	V13	Half-wave rectifier
D104	V8	W8	220-volt isolation	D114	V13	W13	Half-wave rectifier
D105	U9	V9	Full-wave rectifier	D115	U14	V14	DC blocking
D106	V9	W9	Full-wave rectifier	D116	W13	X11	Half-wave rectifier
D107	U10	V10	Full-wave rectifier	D117	W11	W12	Full-wave rectifier
D108	V10	W10	Full-wave rectifier	D118	W10	W8	Full-wave rectifier
D109	U11	V11	Full-wave rectifier	D119	U11	U10	Full-wave rectifier
D110	V11	W11	Full-wave rectifier	D120	U12	U9	Full-wave rectifier

\*All diodes are part No. CE 11950.

TABLE 4—MISCELLANEOUS ELECTRICAL COMPONENTS

Symbol	Part No.	Function
V101	JAN 2D21	Print tube
V102	JAN 2D21	Sharpener tube
V103	JAN 2D21	Shift tube
V104	JAN 12AX7	Gate tube
N101	CE 14517	Figure shift indicator
T101	CE 14508	V102 input coupling
F1, F2	CE 14516	Power circuit protection

~~CONFIDENTIAL~~

**TABLE 5—CURRENT REQUIREMENTS**

Component	Ampereas
Tube filaments	.6
Motor-Generator	1.3
Rotor stepping unit (all seven stepping magnets energized)	.5
Operating light	.1
<b>TOTAL</b>	<u>2.5</u>

The above current requirements are based on a battery power supply of 24 volts DC.

**TABLE 6—JAN WIRE COLOR CODE**

Code Number	Color
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet (Purple)
8	Gray (Slate)
9	White

Wire leads shown in wiring diagrams are identified by numbers which correspond to the JAN wire color code (above) as in the following example:

Body	Broad	1st narrow	2nd narrow
Color	Tracer	tracer	tracer
9	0	3	1
(White)	(Black)	(Orange)	(Brown)

**TABLE 7—WIRING SPECIFICATIONS**

Part No.	Wire Specification	Components Used On
CE 11923	No. 27 gage, c/o 7 strands No. 36 gage, 600v max rated working voltage; fungus resistant insulation, 0.040" dia overall; Surprenant No. 735 U-A10	Contact Panel, Timing Unit, Power Converter, Stepping Unit, Trip Magnet Assy. CE 87420 Motor-Generator
CE 11924	No. 30 gage, c/o 3 strands No. 36 gage .60v max rated working voltage; fungus resistant insulation; 0.030" dia overall	Keyboard Assy, Cipher Unit
CE 11954	No. 24 AWG, c/o 16 strands of No. 36 gage wire; 600v max rated working voltage; Surprenant No. 1636 U-A10	Keyboard Assy, Contact Panel, Stepping Unit, CE 88000 Motor-Generator, AC Power Converter
CE 14765	No. 30 AWG, stranded per BAMCO MS 53016, solder dip, stripped ends in (20%-40%) solder, insulated	Stator and Contact Assy
CE 88153	No. 24 gage, c/o 16 strands of No. 36 gage wire; per BAMCO MS 5316, Surprenant L929	Motor-Generator Assy

~~CONFIDENTIAL~~

KAM-1/TSEC

CHAPTER 6  
MECHANICAL ADJUSTMENTS

6000—GENERAL

**6001. Procedure.**

- a. The following adjustments are arranged in a sequence that would be followed if a complete adjustment of the TSEC/KL-7 cipher machine were undertaken. This fact should be kept in mind when a single adjustment is made since a change in one adjustment may affect other adjustments. Therefore, when one adjustment is made, related adjustments should be checked.
- b. The spring tension values given in this document were derived from measurements made with the actual spring scales specified for these adjustments. These scales are calibrated for use in the vertical "pull" position. When used in any other position, the reading is only an indicated value. Therefore, in order to obtain the proper spring value readings, the spring scales which are specified must be used.
- c. When spiral springs fail to meet tension requirements, the springs should be replaced. **ONLY IN EMERGENCIES SHOULD ATTEMPTS BE MADE TO CHANGE THE TENSION OF DEFECTIVE SPRINGS. SPRINGS THUS REPAIRED SHOULD BE REPLACED AT THE FIRST OPPORTUNITY.**
- d. When a test measurement indicates the part does not meet specifications and no adjustment procedure is given, the part or parts involved should be replaced.
- e. A unique feature in this cipher machine is the pre-formed or "bowed" leaf springs. When adjusting the gaps or tensions for this type spring, take special care not to change its arc.
- f. In order to observe various mechanical operations, it is sometimes necessary to cycle the machine by hand. This may be accomplished as follows:
  - (1) Depress the lower part of the trip magnet armature assembly (fig. 26) and rotate the figured wheel in a clockwise direction as viewed from the front.
  - (2) Continue to rotate the figured wheel until the timing shaft stops turning. The machine will then have completed one full cycle. The detent pawl should then be engaged in the clutch pawl carrier notch.

*Note:* In many adjustments only a partial cycling of the machine is desired. In such cases rotate the figured wheel only so far as is necessary to effect the particular adjustment under consideration.

- g. Disconnect TSEC/KL-7 from its power source before proceeding with any of the mechanical adjustments.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## 6100—CIPHER UNIT

**6101. General.**—For the following adjustments, remove the cipher unit from the machine. Then remove the right-end plate assembly, the eight rotors, and the shell from the cipher unit.

**6102. Plunger Contact Spring Tension (fig. 37-B).**—Apply the push end of an 8-ounce scale vertically to the tip of each plunger contact on the left-end plate assembly and depress until the tip is flush with the contact block surface. It should require 2 to 3 ounces to depress the tip as specified.

**6103. Rotor Plunger Spring Tension (fig. 37-B).**—Apply the push end of an 8-ounce scale vertically to the tip of each plunger contact of the rotor and depress until the tip is flush with the rotor core. It should require 2 to 3 ounces to depress each contact.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

## 6200—ROTOR STEPPING UNIT

*Note:* Remove the cipher unit from the stepping unit.

**6201. Drive Pawl Spring Tension (fig. 37-A).**—With the timing shaft in the stop position, apply the push end of an 8-ounce scale vertically against the point of each drive pawl. It should require  $\frac{1}{2}$  to 3 ounces to move each drive pawl.

**6202. Stop Assembly Spring Tension (fig. 37-A).**—With the timing shaft in the stop position, apply the push end of a 32-ounce scale to each of the stop assembly tips, at right angles to the stop arm. It should require 2 to 10 ounces to move the stop assembly.

**6203. Positioning Arm Spring Tension (fig. 38-A).**—With the timing shaft in the stop position, apply the push end of an 8-ounce scale at right angles to the tip of the positioning arm. It should require 3 to 6 ounces to start the positioning arm moving.

*Note:* The remaining adjustments are to be made with the stepping unit inverted and the bottom cover removed.

**6204. Hold-Down Spring Tension (fig. 38-B).**—Detach each hold-down spring from the drive linkage assembly and remove the spring from the rotor stepping unit. Holding the stud stationary, hook an 8-ounce scale to the spring and extend it until the over-all length of the spring and stud combined equals 1.250 inches. This should require 4 to 6 ounces. As each spring is checked, reassemble it in the rotor stepping unit, attaching the free end to the drive linkage assembly.

**6205. Stepping Magnet Armature Spring Tension (fig. 37-A).**—Rotate the rotor stepping drive shaft until the drive linkage assemblies are in their full forward position. Hook an 8-ounce scale over the end of each stepping magnet armature so that the scale is parallel to the magnet coil. It should require  $\frac{1}{8}$  to  $\frac{1}{2}$  ounce to hold the armature against its core.

**6206. Stepping Magnet Position Adjustment (fig. 37-B).**—Hold one of the stepping magnet armatures against its core and slowly rotate the rotor stepping drive shaft towards the rear of the stepping unit. Continue to rotate the shaft to a position where the midpoint of the drive linkage carrier arc lines up with the end of the rotor stepping magnet armature. Hold the armature against the stepping magnet core and measure the clearance between the armature and the drive linkage carrier arc at the closest point. The clearance should be 0.004 to 0.008 inch. To adjust, loosen the two screws which attach the stepping magnet assembly to the rotor stepping unit frame and position the stepping magnet assembly. Repeat for each of the remaining drive linkage carriers.

**6207. Drive Pawl Effective Length Adjustment (fig. 37-A).**—This adjustment requires a special gage, the CE 87496 adjusting gage. Proceed as follows:

- a. Remove the shell from the cipher unit and place the CE 87496 adjusting gage on the rotor shaft. (Note that the wide-notched section of this two-way gage is to be used in making this adjustment.)
- b. Secure the right side frame on the rotor shaft and insert the cipher unit into the stepping unit. Turn the complete unit upside down.
- c. Loosen all of the eccentric pivot setscrews and rotate each eccentric until its drive pawl is at its least effective length. Rotate the rotor stepping drive shaft to its most forward position (assuming the unit is upright and is being viewed from the front).
- d. Engage the first drive pawl against the front edge of the wide notch in the gage. Then rotate the eccentric forward until the stop pawl engages the back edge of the notch. The drive pawl should be touching (but not binding) on the front of the notch.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

- e. Tighten the setscrew and check to see that the stop disengages freely from the back of the notch when the drive pawl is against the front of the notch.
- f. Repeat steps outlined in subparagraphs *d* and *e* for each of the remaining drive pawls.

#### 6208. Actuator Switch Clearance Adjustment (fig. 38-C).

*Note:* This adjustment requires a special gage, the CE 87496 adjusting gage.

- a. *Preliminary Checks.*—The step-by-step procedure below should be followed before attempting adjustment of the actuator switches.

- (1) Make sure that the contact pileup screws are tight. Remove the four screws that secure the actuator switch assembly to the rotor stepping unit. Free the counter arm from its link, and lift the switch assembly from the stepping unit far enough to make the following checks.

**CAUTION:** If this operation is not made with extreme care, wiring connections may be broken or the actuator spring may be bent or distorted.

- (2) Make sure that the two extensions of the bifurcated (split-leaf) contact springs are parallel so that the two contacts on each spring mate simultaneously.
- (3) All mating contacts must be accurately aligned.
- (4) Make sure that all contact springs rest firmly against their associated stiffeners.
- (5) Adjust the actuator adjusting screws so that equal parts project above and below the actuator assemblies.
- (6) Remount the actuator switch assembly on the rotor stepping unit and check the following items:
  - (a) Make sure that the actuator spring rests against all of the actuator adjusting screws.
  - (b) Make sure that the actuator leaf cap on each pileup rests against the actuator spring.
  - (c) Make sure that the contact springs of each pileup rest firmly against the manual set key plunger.

*Note:* Reference to specific contact clearances listed below may be found on chart shown in figure 38-C.

- b. *Clearances.*—With leaf (5) of each switch resting on its associated set key plunger and with leaf (7) resting against leaf (5), check the following clearances:

- (1) There should be some clearance, not more than 0.010 inch, between leaf (7) and stiffener (6). To adjust, bend stiffener (6).
- (2) Clearance 21 should be between 0.015 and 0.020 inch. To adjust, bend stiffener (4).
- (3) Clearance 20 should be between 0.012 and 0.015 inch. To adjust, bend stiffener (2).

- c. *Preparation for Use of the Actuator Adjusting Gage.*

- (1) Rotate the rotor stepping drive shaft so that the camming surfaces move to the rear. Trip off each of the stepping magnet armatures, thus permitting the drive linkage assemblies to move to the rear.
- (2) Set the stepping unit upright and remove the set key plate and the No. 4 plunger. Replace the set key plate with the fronts of the set keys facing the rear of the stepping unit. This gives access to the actuator switch adjusting screws and allows all of the (5) leaves to remain in their relative positions, excepting the leaf for the No. 4 actuator switch.
- (3) Invert the stepping unit.
- (4) Remove the shell assembly from the cipher unit and place the CE 87496 adjusting gage on the cipher unit shaft so that the surface engraved with the numerals faces right. Mount the cipher unit on the stepping unit.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

*d. Clearances.*

*Note:* Actuators which are operated by the rotor notch rings are not to be confused with the actuator switches. For purposes of this adjustment, the actuators are numbered No. 1 through 7 from left to right.

- (1) Rotate the adjusting gage so that camming surface 1 rests on the No. 1 actuator. There should be a clearance of 0.025 to 0.035 inch between leaves (7) and (8). To adjust, position the actuator adjusting screw.
- (2) Rotate the adjusting gage so that camming surface 2 rests on the No. 1 actuator. The contacts of leaf (10) should barely make contact with the contacts of leaf (12). To adjust, bend stiffener (11).
- (3) Rotate the adjusting gage so that camming surface 3 rests on the No. 1 actuator. The contacts of leaf (10) should barely mate with the contacts of leaf (8). To adjust, bend stiffener (9).
- (4) Repeat steps outlined in subparagraphs (1) through (3) above for actuator switches No. 2, 3, 5, and 6. Repeat steps outlined in subparagraph (2) above for actuator switches No. 4 and 7.
- (5) Remove the adjusting gage from the cipher unit. Remove the set key plate and replace the No. 4 plunger. Remount the key plate in its normal position.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

## 6300—PRINTER UNIT

**6301. Drive Link Spring Tension (fig. 31-B).**—With the timing shaft in the stop position, apply the push end of a 32-ounce scale to the upper edge of the drive link near the yoke. Push down in line with the spring. It should require 22 to 30 ounces to start the drive link moving.

*Note:* Remove the printer unit from the contact panel assembly before proceeding with the following adjustments.

**6302. Crankshaft Miter Gear Backlash Adjustment (fig. 31-A).**

- a. Remove the drive link assembly from the printer unit, and with the timing shaft in the stop position, measure the crankshaft miter gear backlash by moving the crankpin vertically. This movement should be 0.002 to 0.006 inch.
- b. If adjustment is necessary, the following preliminary steps must first be performed. First remove the motor generator and controller assembly and the timing unit assembly from the printer unit. Then, remove the two screws which secure the crankshaft to the gear housing. Note that considerable force may be necessary to remove the assembly even after the screws are removed.
- c. To adjust, add to or remove from the number of shims which fit between the crankshaft mounting flange and gear housing. If the backlash movement was too great, remove shims; if it was too little, add shims.
- d. To check the adjustment, insert the crankshaft assembly back into the gear housing, making certain that the cutout portion of the drum cylinder is visible. Set the crankpin so that its center line points down and lines up with the two screw holes (fig. 31-A). Then repeat steps outlined in subparagraphs a and c above.

**6303. Timing Unit Adjustments.**—Adjustments pertaining to this section of the printer unit are outlined in paragraphs 6304 thru 6311.

**6304. Timing Unit Pressure Contact Compression (fig. 31-C).**—With the printer inverted apply the push end of an 8-ounce scale to the tip of each pressure contact and press down in line with the plunger. It should require  $4\frac{1}{2}$  to 8 ounces to depress the tip flush with the contact block surface.

**6305. Timing Unit Cam Switch Adjustments (fig. 32-A).**

*Note:* Reference to specific clearances and spring tensions listed below may be found in chart shown in figure 32-A. Observe that in this chart, pictorial reference to the dampening leaves has been omitted.

- a. With the timing shaft in the stop position and with leaf (3) of each cam switch bearing upon the low cam surface, clearance 8 should be 0.012 to 0.015 inch for each cam switch. To adjust, bend stiffener (2) of defective cam switches.
- b. Manually cycle the machine until leaf (3) of each cam switch is bearing upon the high cam surface. Clearance 10 should be 0.012 to 0.015 inch for each cam switch. To adjust, bend stiffener (4) of defective cam switches.
- c. With the timing shaft in the same position as stated in subparagraph (2) above, leaf (5) of each cam switch will be bearing against stiffener (4). Apply the push end of an 8-ounce scale at the contact of leaf (5) and at right angles to the leaf. Spring tension 9 should be ~~11~~ to ~~11~~ ounces. To adjust, bend leaf (7) of defective cam switches. 2 8

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- d. Return the timing shaft to its stop position. Leaf (3) of each cam switch will be bearing upon the low cam surface. Apply the hook end of an 8-ounce scale to leaf (3), next to the contact and at right angles with the leaf. Spring tension 6 should be  $\frac{1}{4}$  to  $\frac{1}{9}$  ounces. To adjust, bend leaf (3) of defective cam switches.
- e. With the timing shaft in the same position as stated in subparagraph (4) above, leaf (1) of each cam switch will be tensioned against stiffener (2). Apply the hook end of an 8-ounce scale to the end of leaf (1) at a point which is next to the contact and at right angles to the leaf. Spring tension 7 should be  $\frac{1}{2}$  to  $\frac{1}{4}$  ounces. To adjust, bend leaf (1) of defective cam switches.

**6306. Timing Unit Detent Pawl Spring Tension (fig. 33-D).**—Manually rotate the figured wheel until the detent pawl is disengaged and is bearing upon the periphery of the clutch pawl carrier. Hook a 8-ounce scale on the detent pawl spring pin and pull in direct line with the spring. It should require 3 to 4 ounces to start the detent pawl moving.

**6307. Clutch Pawl Spring Tension (fig. 33-C).**—With the trip magnet armature removed and the detent pawl engaged in the clutch pawl carrier notch, apply the push end of an 8-ounce scale to the edge of and at right angles to the clutch pawl. It should require  $1\frac{1}{2}$  to  $2\frac{1}{2}$  ounces to move the pawl against the clutch pawl stop.

**6308. Trip Magnet Armature Spring Tension (fig. 33-B).**—With the timing unit in its stop position, apply the push end of an 8-ounce scale at right angles to the bottom armature rivet. It should require  $\frac{1}{2}$  to 2 ounces to disengage the trip magnet armature from the clutch pawl.

**6309. Trip Magnet Position Adjustment (fig. 33-A and 33-B).**

- a. Rotate the figured wheel until the extension on the clutch pawl is even with the top edge of the contact plate. Hold the armature against the core and measure the clearance between the clutch pawl and the contact plate at the closest point. Clearance should be 0.010 and 0.020 inch.
- b. To adjust, change the setting of the three trip magnet adjusting screws (see fig. 33-A) at the top of the bracket. If the clearance is less than that specified, back off the two outer screws and tighten the center screw. This will move the contact plate away from the clutch pawl. If the clearance is greater than that specified, back off the center screw and tighten the two outer screws. This will move the contact plate toward the clutch pawl. Apply glyptal at the junction of the screw threads and to the bracket after the adjustment is completed. *The Fed. Cyl. Stock No. (FSN) For 617041 is 8914-161-7327. The Signal Corps Stock No. is 662190.*

Note: If the trip magnet adjusting screws are reset as required in this adjustment, the adjustment described in paragraph 6310 below should be checked.

**6310. Trip Magnet Armature Gap Adjustment (fig. 33-E).**—With the timing shaft in the stop position, there should be a gap of no more than 0.020 inch between the armature contact plate and the cores of the trip magnet at the closest point. This tolerance must be met with respect to the relationship between the outer face of the contact plate and the end of the clutch pawl. The plate and pawl should be flush, but the plate may extend up to 0.010 inch beyond the clutch pawl. To adjust for both this clearance and the trip magnet armature gap, bend the guard at its lower bend. If both tolerances cannot be met by bending the guard, refine the adjustment outlined in paragraph 6309 above.

Note: When bending the guard, make certain that it does not interfere with the action of the contact plate.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

**6311. Timing Unit Detent Pawl Adjustment (fig. 33-D and 33-E).**

- a. Position the timing shaft to its stop position. With the contact plate holding the clutch pawl out of engagement from the clutch drive assembly ratchet (fig. 33-E), the clutch pawl tooth should just clear the clutch drive ratchet, i. e., there should be just enough clearance so that no buzzing noise can be heard.
- b. To adjust, loosen the eccentric stud setscrew and turn the eccentric stud (fig. 33-D) until there is a clearance of 0.006 to 0.010 inch between the extension on the clutch pawl and the lower edge of the clutch pawl stop. Remount the printer unit on the machine and turn on the motor-generator. Rotate the eccentric stud in a direction which decreases the effective length of the detent pawl. Turn the stud until a buzzing sound is heard and then turn the eccentric back until the buzzing sound disappears. Tighten the eccentric stud setscrews.

**6312. Pulse Generator Pressure Contact Compression (fig. 31-C).**—With the printer unit inverted, apply the push end of an 8-ounce scale to the tip of each pressure contact and press down in line with the plunger. It should require  $4\frac{1}{2}$  to 8 ounces to depress the tip flush with the surface of the contact block.

**6313. Tape Feed Mechanism Adjustments.**—Adjustments pertaining to this section of the printer unit are outlined in paragraphs 6314 through 6322 below.

**6314. No-Back Pawl Spring Tension (fig. 32-B).**—Position the timing shaft in the stop position. The no-back pawl should be engaged behind a tooth of the single-drive ratchet. Hook an 8-ounce scale around the pawl, near the engagement point, and pull at right angles to the inner edge of the pawl. It should require 2 to 4 ounces to start the pawl moving.

**6315. Single-Drive Ratchet Pawl Spring Tension (fig. 32-B).**—Manually cycle the machine until the single-drive ratchet pawl reaches the lowest point of its downward travel. In this position, the pawl will be disengaged from the single-drive ratchet. Apply the push end of a 32-ounce scale against the pawl and in line with the spring. It should require  $3\frac{1}{2}$  to  $5\frac{1}{2}$  ounces to start the pawl moving.

**6316. Detent Ratchet Pawl Spring Tension (fig. 32-B).**—Rotate the paper feed roll counterclockwise, as viewed from the front, until the detent ratchet pawl spring is positioned horizontally across the top of its rotation. Then rotate the paper tape feed roll clockwise to seat the ratchets. Hook an 8-ounce scale over the detent ratchet pawl lever at the spring and pull in line with the spring. It should require 7 to 8 ounces to start the lever moving.

**6317. Double-Drive Ratchet Spring Compression (fig. 32-C).**—Rotate the paper feed roll counterclockwise, as viewed from the front, until both the double-drive ratchet and the stop ratchet are engaged by the stop pawl. Rotate the paper tape feed roll clockwise to seat the ratchets. Disengage the stop pawl by depressing the bracket assembly plunger. This allows the compression spring to rotate the double-drive ratchet so that its teeth are no longer in line with those of the stop ratchet. Holding the plunger depressed, apply the push end of an 8-ounce scale at right angles to a tooth of the double-drive ratchet. It should take from 1 to 2 ounces to start the double-drive ratchet moving.

**6318. Stop Pawl Spring Tension (fig. 32-C).**—Disengage the stop pawl by depressing the bracket assembly plunger. The stop pawl will bear upon the periphery of the double-drive ratchet. Hook a 32-ounce scale under the stop pawl, next to the pawl tooth, and pull at right angles to the inner edge of the pawl. It should require 15 to 17 ounces to start the stop pawl moving.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

**6319. Double-Drive Ratchet Pawl Spring Tension (fig. 32-C).**—Rotate the paper tape feed roll counterclockwise until the stop pawl engages both the double-drive ratchet and the stop ratchet. The double-drive ratchet pawl will now bear upon the outer diameter (i. e., not in a tooth) of the smaller double-drive ratchet. Rotate the paper tape feed roll clockwise to seat the ratchets. Apply the push end of an 8-ounce scale to the double-drive ratchet pawl at the pawl spring and push in line with the spring. It should require 2 to 4 ounces to start the double-drive ratchet pawl moving.

**6320. No-Back Pawl Adjustment (fig. 32-B).**

*Note:* The adjustments described in this subparagraph and in paragraph 6321 below are related and must be made in the sequence given.

- a. Manually cycle the machine until the single-drive ratchet reaches the top limit of its driving stroke. The no-back pawl should be seated precisely against the trailing edge of a single-drive ratchet tooth. Continue to rotate the figured wheel until the above has been checked for each of the 24 single-drive ratchet teeth.
- b. To adjust, loosen the two setscrews on the no-back pawl adjusting eccentric. Turn the eccentric so as to alter the effective length of the no-back pawl to meet conditions described in subparagraph *a* above. Tighten the two setscrews, and check the adjustment by rotating the figured wheel until the single-drive ratchet has completed one full revolution.

**6321. Double-Drive Ratchet Pawl Adjustment (figs. 32-B and 32-C).**

- a. The no-back pawl must be adjusted as described in paragraph 6320 above. With the timing shaft in its stop position, rotate the paper tape feed roll counterclockwise until the stop pawl is fully engaged with both large diameter double-drive ratchet and the stop ratchet.
- b. With the bracket assembly plunger held depressed, rotate the paper tape feed roll counterclockwise until five single-drive ratchet teeth have passed under the no-back pawl. Then, check the double-drive ratchet pawl for the following requirements:
  - (1) With the plunger still held depressed, manually cycle the machine one full revolution. Two single-drive ratchet teeth should have passed under the no-back pawl, and the no-back pawl should be firmly set against the trailing edge of the single-drive ratchet tooth.
  - (2) With the plunger released, manually cycle the machine until the stop pawl fully engages both the large diameter double-drive ratchet and the stop ratchet. No more than one single-drive ratchet tooth should have passed under the no-back pawl during any timing shaft operation.
  - (3) With the plunger and the trip magnet armature held depressed, turn the timing shaft through 31 revolutions by rotating the figured wheel clockwise. Two teeth should pass under the no-back pawl during the sixth revolution, and thereafter during every fifth revolution, i. e., the eleventh, sixteenth, twenty-first, twenty-sixth, and thirty-first.
- c. To adjust, loosen the two setscrews on the double-drive ratchet pawl adjusting eccentric. (If not readily accessible, manually cycle the machine until the setscrews can be reached.) Turn the eccentric until the mechanism operates as described in subparagraphs (1) through (3) above, and tighten the two setscrews. Check the adjustment by rotating the mechanism with the stop pawl disengaged through one full revolution of the single-drive ratchet.

**6322. Feed Roll Follower Spring Tension (fig. 34-C).**—Apply the push end of a 32-ounce scale to the feed roll follower bracket at right angles to the frame. It should require 22 to 26 ounces to start the feed roll follower moving.

*Note:* Replacement of the follower spring involves the removal of several parts. If, in the above check, the spring is found to be not satisfactory replacement may be made during the check described in paragraph 6324 below, providing a complete readjustment of the printer is being made.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

**6323. Ribbon Reversing Mechanism Adjustments.**—Adjustments pertaining to this section of the printer unit are outlined in paragraphs 6324 and 6325 below.

**6324. Shifting Lever Spring Tension (fig. 34-B).**

- a. Remove the print magnet, the metal spools and ribbon, the figured wheel, the paper tape feed roll, and the front end bell cover. Remove the rear ring gear from the ribbon reversing mechanism.
- b. Apply the hook end of a 32-ounce scale behind the spring end of the shifting lever. Hold the ribbon drive gear and pull in line with the spring. It should require about 20 to 24 ounces to start the shifting lever moving.

**6325. Ribbon Spool Compression Spring Tensions (fig. 35-B).**—The inked ribbon should be reversed from either spool within a minimum of two operations. If this tolerance is not met and the shifting lever spring tension is correct as prescribed in paragraph 6324 above, check the ribbon spool compression spring tensions as follows:

- a. Remove the ribbon reversing mechanism from the front end bell cover by first removing the right-reel drive gear. Replace the right-reel drive gear, making sure the compression spring and break washer are correctly mounted.
- b. From the front of the front end bell cover, hook the pull end of an 8-ounce scale to the top-most hole in the left-reel drive assembly. Pull in a counterclockwise direction. It should require from 3 to 4 ounces to start the assembly moving.
- c. Repeat the same steps for the right-reel drive assembly. ~~It should require from 4 to 5 ounces to start this assembly moving.~~

**6326. Print Magnet Adjustments.**—Adjustments pertaining to this section of the printer unit are outlined in paragraphs 6327 through 6329.

**6327. Print Magnet Pressure Contact Spring Compression (fig. 31-C).**—With the printer unit inverted, apply the push end of an 8-ounce scale to the tip of each pressure contact and depress in line with the plunger until the tip is flush with the contact block surface. It should require  $4\frac{1}{2}$  to 8 ounces to depress the contact.

**6328. Print Magnet Reed Spring Tension (fig. 35-A).**—Apply the push end of an 8-ounce scale to the armature channel at a point just over the magnet core. Depress the armature until it contacts the core. It should require 1 to 3 ounces to hold the armature against the core.

*Note:* Before proceeding with the following adjustments, the figured wheel must be correctly adjusted as prescribed in paragraph 6336.

**6329. Print Magnet Eccentric Adjustment (fig. 35-A).**—With the cipher machine fully assembled and operating in the P, E, or D position, the print hammer must strike the paper tape in such a manner that sharp clear print is obtained. If this requirement is not met, adjust the print hammer eccentric as follows:

- a. Loosen the two print magnet assembly mounting screws until they are only friction tight. Use the CE 87497 wrench to reach these screws without removing the keyboard.
- b. Using the CE 87498 print magnet adjusting tool, turn the eccentric until proper printing is obtained.

**6330. Motor-Generator and Controller Adjustments.**—Adjustments pertaining to this section of the printer unit are outlined in paragraphs 6331 through 6335.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

**6331. Motor Brush Spring Tension.**—Remove the motor-generator and controller assembly from the rear end bell. Then remove the controller and end cover from the motor-generator assembly. Unscrew, but do not remove, the brush retaining cap, and leave the brush in contact with the motor commutator. Apply the push end of an 8-ounce scale at right angles to each brush retaining cap top and push in line with the spring (see fig. 35-C). It should require  $2\frac{1}{2}$  to  $4\frac{1}{2}$  ounces to just hold the brush retaining cap in contact with the brush holder. Replace the brush retaining cap.

**6332. Motor-Generator and Controller Pressure Contact Compression** (figs. 32-C and 31-D).—With the printer inverted, apply the push end of an 8-ounce scale to the tip of each pressure contact. Depress in line with the plunger until the tip of the contact is flush with the surface of the terminal block. It should require 3 to  $5\frac{1}{2}$  ounces for the heavy duty type pressure contacts (N1 and N2) and  $4\frac{1}{2}$  to 8 ounces for the other pressure contacts.

**6333. Motor-Generator and Controller Pressure Contact Alignment.**

- a. When remounting the controller to the motor-generator, use a straightedge to make certain that the pressure contact tips of the motor-generator and controller are even with those of the timing unit, the pulse generator, and the print magnet.
- b. To adjust, loosen the two screws which attach the controller to the motor-generator assembly. Align the pressure contact tips by shifting the position of the controller. Retighten the two screws.

**6334. Motor-Generator Speed Adjustment** (fig. 34-G).

- a. Mount the printer unit on the contact panel assembly and set the counter at zero. With 24-volts DC applied to the cipher machine, position the selector handle to the P position and hold the trip magnet armature disengaged for one minute. The counter should read from 580 to 620 operations.
- b. When the complete cipher machine is not available, motor speed may be checked with a revolution counter in the following manner: Connect input pressure contacts N1 and N2 of the motor generator to a 24-volt DC source. Observe the motor speed by means of a revolution counter applied to the figured wheel. The speed of the figured wheel should be 2150 to 2250 rpm.
- c. To adjust, remove the cover and the insulator assembly from the controller. Loosen the locking screws and move the sliding contact on the adjustable resistor until the speed is as specified. Tighten the locking screw.

*Note:* See paragraph 6337 for motor speed adjustment when using CE 88000 motor-generator and controller assembly.

**6335. Generator Output Voltage** (fig. 34-G).—With the motor-generator running at the correct speed (see paragraph 6334 above), connect a voltmeter (Simpson model 260) across the output terminals of the generator, M3 and M4. The voltmeter should read 150-volts AC.

**6336. Figured Wheel Adjustment** (figs. 34-C through 34-F).

- a. Set the cipher machine for P operation and depress the LET key switch. Type a row of X's with no spaces between. If the figured wheel is properly adjusted, the X's will appear as in figure ~~34-E~~ 34-E.
- b. If the figured wheel is positioned too far counterclockwise, the print hammer will strike the wheel too soon, resulting in the printing of the right side of the figure 6 and the left side of letter X (see fig. 34-D).
- c. To adjust, loosen the three screws (fig. 34-C), and using the CE 87493 adjusting tool (if available) move the figured wheel clockwise to compensate for the error. Tighten the screws.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

- d. If the figured wheel is positioned too far clockwise, the print hammer will strike the wheel too late, resulting in the printing of the left side of the letter H and the right side of the letter X (see fig. 34-F).
- e. To adjust, loosen the three screws (fig. 34-C), and move the figured wheel slightly counter-clockwise to compensate for the error. Tighten the screws.
- f. To check the adjustment, place the selector handle in the P position, depress the FIG key switch, and type a row of X's as described in subparagraph a above.

6337. Motor-Generator Speed Adjustment (Governor Type).<sup>(fig. 34-D)</sup> The print wheel should rotate at 2200 rpm ~~1700 rpm~~ when using a 21 volt DC input in E operation. Use a strobotac when reading the speed of the figured wheel. To adjust for the correct motor speed proceed as follows:

- a. Remove the end cover.
- b. If the motor speed should be slowed down, move in the upper adjusting screw on the governor contacts.
- c. If the motor speed should be increased, move out the upper adjusting screw on the governor contacts.
- d. If the upper adjusting screw is disturbed, the 0.031 inch air gap between the two governor contacts must be reestablished. This is accomplished by adjusting the lower adjusting screw.
- e. Replace the end cover and recheck motor speed.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## 6400—KEYBOARD ASSEMBLY

**6401. Key Switch Spring Compression (fig. 36-A).**—Remove the keyboard from the cipher unit. Apply the push end of an 32-ounce scale vertically against each key top, excepting the RPT key top, and push down until the plunger is fully depressed. It should require 6 to 12 ounces to fully depress the key.

**6402. RPT Key Switch Spring Compression (fig. 36-B).**—Apply the push end of a 32-ounce scale vertically against the RPT key top and push down until the plunger is fully depressed. It should require 6 to 17 ounces to fully depress the key.

**6403. Space Bar Spring Tension (fig. 36-C).**—Apply the push end of an 8-ounce scale vertically against the center of the upper surface of the space bar. Push down until the space bar begins to move. It should require 3 to 8 ounces to start the space bar moving.

**6404. Power Switch Leaf Tension (fig. 36-D).**—With the keyboard inverted, apply the push end of an 8-ounce scale vertically against each power switch leaf assembly contact and push toward the key chassis. Move the contact surface to a point  $\frac{1}{2}$  inch from the key chassis. It should require  $1\frac{1}{2}$  to  $2\frac{1}{2}$  ounces to move the contact to this point.

**6405. Space Bar Pressure Contact Compression (fig. 31-C).**—With the keyboard inverted, apply the push end of an 8-ounce scale vertically against the tip of the space bar pressure contact. Depress the contact until the tip is flush with the barrel of the pressure contact assembly. It should require  $3\frac{1}{2}$  to 8 ounces to depress the contact tip flush with the barrel of the pressure contact assembly.

**6406. Selector Handle Detent Action:**—Rotate the selector handle through the four positions. The pointer should come to rest at each position with a positive action, and it should require appreciable effort to move the selector handle from one position to another. If the detent action is not positive or is too stiff, the spring located in the retainer should be replaced.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

6500—PANEL AND BASE ASSEMBLY

6501. Contact Panel Pressure Contact Compression (fig. 31-C and 31-D). <sup>AND FIG 58</sup> Remove the cipher unit, the rotor stepping unit, the printer, the keyboard, and the sliding contact board.

a. Apply the push end of an 8-ounce scale to the tip of pressure contacts K1 and K2. Depress in line with the plunger. It should require 3 to 5½ ounces to depress each tip flush with the upper surface of the contact panel.

b. Apply the push end of a 32-ounce scale to the tip of pressure contact K27. Depress in line with the plunger. It should require 6 to 9½ ounces to depress the tip flush with the upper surface of the contact panel.

c. Apply the push end of an 8-ounce scale to the tip of each remaining pressure contact in the contact panel and depress in line with the plunger. It should require 4½ to 8 ounces to depress each tip flush with the upper surface of the contact panel. <sup>TIPS of pressure contacts K6 and those of the A, D, and E-PREFIXED Groups should require 2½ to 8 ounces to depress the tips flush with upper surface of contact panel.</sup>

6502. Contact Panel Follower Spring Tension (fig. 36-E).—Apply the push end of an 8-ounce scale to the forward end of the follower. It should require 1 to 3 ounces to start the follower moving.

6503. Stop Pin Spring Tension (fig. 36-F).—With the base inverted, apply the push end of a 32-ounce scale to the end of one of the two stop pins. Depress in line with the pin. It should require from 4 to 12 ounces to depress the tip flush with the bottom surface of the base. Repeat for the other pin.

6504. Operator's Light Socket Pressure Contact Compression (fig. 31-C).—Apply the push end of an 8-ounce scale to the tip of each pressure contact. It should require 4½ to 8 ounces of pressure to depress each tip flush with the inside surface of the socket.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

CHAPTER 7  
CLEANING AND LUBRICATION

7000—GENERAL INFORMATION

7001. Introduction.

- a. Proper attention to cleaning and lubricating of TSEC/KL-7 is of the utmost importance. The equipment must not be overly lubricated, but adequately lubricated. Adequate lubrication means that a thin film of oil or grease should be maintained between all bearing surfaces so there will be a negligible amount of wear. It is difficult to specify a definite schedule for complete lubrication of TSEC/KL-7 because of varying operating conditions. Dust, humidity, temperature, and volume of traffic must be taken into consideration when setting up a lubrication schedule. Equipment operating in temperatures below 40 degrees Fahrenheit may require more frequent lubrication than those working in temperatures above 40 degrees Fahrenheit.
- b. The lubricants specified in this document are obtainable from the same sources that normally furnish replacement parts.
- c. Although the sequence of instructions presented herein assume a complete overhaul of TSEC/KL-7, major components such as the printer assembly, stepping unit, cipher unit, etc., can be cleaned and lubricated individually. However, it is well to remember that when disassembling individual parts from a major assembly, the sequence described should be followed closely to insure an accurate adjustment of the machine.

~~CONFIDENTIAL~~

ORIGINAL

7100—PROCEDURES FOR OPERATING PERSONNEL

7101. General Instructions.

- a. *Limitations.*—Cleaning should be carried out as prescribed in these instructions and should be confined to the items specified. The only maintenance the operator is required to perform is that known as "preventive" maintenance. In performing this type of maintenance, care must be taken so as not to disturb springs or adjustments. Remove dirt and dust from exposed surfaces of the cipher machine by means of a sashbrush-type cleaning brush. Careless cleaning on the part of the operator may cause troubles to develop at a later date. The instructions in this section, however, have been arranged to prevent such troubles, and it is therefore important that they be closely followed.
- b. *Frequency.*—Scheduled cleaning periods cannot be definitely prescribed because of varying operating conditions. Dust, humidity, temperature, and the volume of traffic must be taken into consideration when setting up cleaning schedules.
- c. *Tools and Materials.*—The following tools and materials are recommended to the operator for performing preventive maintenance on TSEC/KL-7.

*Note:* This listing contains *all* of the recommended tools and cleaning materials even though requirements will vary between Services. Specific maintenance policies in regard to the operator will be set by the individual Service.

- (1) The operator's accessory kit, part No. 87290, including the following components:
  - (a) Sashbrush-type cleaning brush. Part No. CE 87291.
  - (b) Toothbrush-type cleaning brush. Part No. CE 87292.
  - (c) Cleaning block assembly with CE 87299 web strap. Part No. CE 87293. (see Note on page 135)
  - (d) Eraser. Part No. CE 87296
  - (e) Container of Quietone lubricant, 8-ounce can. Part No. CE 87297.
  - (f) Package of Twilljean cloth. Part No. CE 87298.
  - (g) Web strap for CE 87293 cleaning block assembly. Part No. CE 87299.
- (2) The operator's maintenance kit, part No. CE 87450, includes the CE 87290 operator's accessory kit and the following parts in the CE 87470 wrench set:
  - (a) 3/16-inch Allen key. Part No. CE 87473.
  - (b) Small paintbrush-type cleaning brush. Part No. CE 87474.
  - (c) 1/8-inch plastic-handle Allen key. Part No. CE 87475.
  - (d) 3/32-inch plastic-handle Allen key. Part No. CE 87476.
  - (e) 3/16-inch blade for CE 87478 T-handle Allen key. Part No. CE 87477.
  - (f) 3/16-inch T-handle Allen key. Part No. CE 87478.
  - (g) 3/32-inch blade for CE 87480 T-handle Allen key. Part No. CE 87479.
  - (h) 3/32-inch T-handle Allen key. Part No. CE 87480.

d. *Authority.*—Obtain the necessary authority for release of the equipment.

e. *Preparation for Cleaning.*

- (1) Before proceeding with any cleaning of TSEC/KL-7, disconnect the machine from its power source. Remove the machine from its carrying case by depressing the retaining spring and pulling out the machine beyond the two stop pins. If necessary, clean the case.
- (2) If the machine is being operated in an office case, remove the four screws from the bottom which secure the machine to the case and remove the machine. Unscrew the four captive screws on the power converter and remove the power converter from the case.

~~CONFIDENTIAL~~

KAM-1/TSEC

**7102. Flat Head and Pressure Contacts (figs. 5, 12, and 18).**

*a. Flat Head Contacts on Rotors and Cipher Unit Right End Plate.*

- (1) **Schedule.**—A routine cleaning and lubricating schedule should be established in accordance with local operating conditions. Rotors will be cleaned and lubricated each time they are assembled for use. A routine cleaning and lubricating schedule depends on type of lubricant used, ambient temperature, relative humidity, and number of hours equipment is being operated. Quietone and Kleenlube can be expected to provide 18 to 24 hours of error-free operations; Quietrole, approximately 8 hours. Under normal operating conditions, an eraser should not be used to clean rotor contacts more than once every 30 days.
- (2) **Cleaning and Lubricating.**—Remove old lubricant with a Twilljean cloth. If rotor contacts still are excessively discolored or heavy amounts of dirt remain after using the Twilljean, then use an eraser to restore the clean and dirt free appearance that is necessary for error-free operation. Apply a generous coating of lubricant to the contacts and to the ground surface of the rotor as well. (The ground surface of the rotor is the non-glossy area of the bakelite.) Quietone or Kleenlube should be applied with a brush applicator in three separate coats. Spread the lubricant evenly after each coat and allow it to dry. (Quietrole needs only one generous coat.)

*Note:* Contacts on new rotors may be dirty and discolored from prolonged storage and shipping. An eraser may be used to clean these rotors before they are put into use.

- b. Other Flat Head Contacts.*—Clean with Twilljean cloth or, when necessary, with an eraser. It is not necessary to lubricate contacts other than those on the rotor or end plate.
- c. Pressure Contacts.*—Clean the pressure contacts by polishing them with a canvas cleaning block. Do not apply any lubricant to the pressure contacts.

**7103. Procedures.**

*a. Cipher Unit Assembly.*

- (1) Unlatch the cipher unit and remove it from the stepping unit. A guide plate on the stepping unit insures against damage to pressure contacts while the cipher unit is being removed or inserted.
- (2) Remove the right-end plate from the cipher unit by snapping its latch forward. Take care that the rotors do not spill out.
- (3) Tilt the cipher unit in such a manner as to permit the eight rotors to slide off their shaft, noting the sequence in which they are removed so that replacement can be made in the same order.
- (4) Clean and lubricate the cipher unit as follows:
  - (a) Clean the flat head and pressure contacts on the left-end plate.
  - (b) Clean and lubricate the flat head contacts on the face of the right-end plate. Clean the flat head contacts on the bottom of the end plate.
  - (c) Clean and lubricate each of the eight rotors as follows:
    1. Clean the pressure contacts.
    2. Clean and lubricate the flat head contacts.
  - (d) Clean old lubricant from the cipher unit shaft. Apply thin coat of Stano-Drip oil (or Quietrole).
- (5) Slide out the cipher unit window from the right side of the window frame. Clean the window and the cipher unit shell and then replace the window.

*b. Stepping Unit Assembly (fig. 30).*—To remove the stepping unit, unlock the two screw assemblies by twisting their handles in a counterclockwise direction. Once unlocked, the screws may be completely loosened by hand. Remove the stepping unit from the contact panel by lifting upward and slightly towards the front of the cipher machine. Clean as follows:

- (1) Clean the pressure contacts on each of the two reentry blocks.
- (2) Clean the flat head contacts on the stepping unit contact block.

*c. Rotors.*—Flat head and pressure contacts on the rotors are to be cared for as outlined in subparagraph *a(4)(c)* above. Only the flat head and pressure contacts on the rotors need be cleaned or lubricated unless excessive dirt and grime are present. If so, the following outlines a step-by-step procedure for disassembly and care of an individual rotor.

- (1) Note the relative positions, by index marks, of the alphabet ring to the rotor core and of the notch ring to the alphabet ring.
- (2) Remove the retaining ring.
- (3) Remove the notch ring.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (4) Separate the rotor core from the alphabet ring.

Note: To disassemble the stationary rotor, remove the retaining ring; then separate the stationary ring from the rotor core.

- (5) Clean the rotor core with dry Twilljean cloth. Clean the pressure contacts. Clean and lubricate the flat head contacts.
- (6) Clean the notch ring with dry Twilljean cloth.
- (7) Clean the alphabet ring with dry Twilljean cloth.

d. *Printer Assembly (fig. 13).*

**CAUTION: DO NOT REMOVE ANY OF THE DUST COVERS FROM THE PRINTER WITH THE EXCEPTION OF THE RIBBON DUST COVER.**

- (1) With the stepping unit removed from the machine, loosen the four printer assembly captive screws and lift the printer assembly vertically from the contact panel.
- (2) Clean the print magnet assembly using the small sashbrush-type cleaning brush. Take care not to bend the reeds.
- (3) Clean the pressure contacts on the underside of the printer assembly.
- (4) Remove the ribbon dust cover.
- (5) Remove the inked ribbon and clean the figured wheel with a toothbrush-type cleaning brush which has been dipped in a Service-approved cleaning solvent, if available. Note that the characters on the figured wheel can be reached through the slot at the top of the ribbon track. Clean all characters thoroughly and replace the ribbon (see subpar. 3003c) and dust cover.

e. *Keyboard and Sliding Contact Board and Guide Rail Assemblies.*

- (1) Turn the selector handle to D position and loosen the five captive screws which mount the keyboard assembly to the contact panel. If done with care, the sliding contact board, which is mounted underneath the keyboard, will remain in position and can be lifted from the contact panel together with the keyboard assembly.

**CAUTION: IF THE KEYBOARD IS CARELESSLY LIFTED FROM THE CONTACT PANEL, THE SLIDING CONTACT BOARD AND GUIDE RAIL ASSEMBLY MAY DROP OUT, CAUSING DAMAGE TO PRESSURE CONTACTS UNDERNEATH.**

- (2) Clean all of the flat head contacts on the sliding contact board and guide rail assembly.

f. *Contact Panel Assembly (fig. 12).*

- (1) Clean the top surface of the contact panel assembly with a paintbrush-type cleaning brush, devoting particular attention to the small spaces between adjacent contacts.
- (2) Clean the pressure contacts.
- (3) Clean the flat head contacts.
- (4) Clean the canopy of the lamp socket assembly with Twilljean cloth.

**7104. Reassembly Instructions.**

- a. To remount the sliding contact panel and guide rail assembly, place the assembly on the contact panel so that the cam (fig. 12) is to the left of the tape feed follower. The guide rails must be face up.
- b. Replace the keyboard assembly as follows:
  - (1) Pull up on each of the five captive screws and turn them counterclockwise until they screw slightly into the keyboard housing.
  - (2) Make certain the selector handle is in the D position.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (3) Mount the keyboard assembly on the contact panel so that the five captive screws fit firmly into the five stand-off spacers. Tighten the five screws.

c. Assemble the individual rotors as follows:

- (1) Set the alphabet ring on the rotor core so that the arrow on the core points to its correct numerical designation on the ring. Wiggle the alphabet ring to make certain the core and ring dovetail.
- (2) Set the notch ring onto the core so that its two white indicator lines correctly line up with the designated letter on the alphabet ring.
- (3) Set one ear of the retaining ring into the rotor core groove. Then, while holding this position with the thumb and forefinger of one hand, run the thumb of the other hand along the periphery of the ring, exerting continuous pressure until the ring is fully seated in its groove.
- (4) When the rotor is assembled, check the arrow and line indicators on the rotor core and notch ring to determine whether the rotor settings are correct. Then, gripping the alphabet ring with one hand and the notch ring with the other, twist in opposite directions. If the rotor is correctly assembled, there will be no slippage whatsoever.

*Note:* In assembling the stationary rotor, mount the stationary ring to the rotor core in a manner similar to that described for the alphabet ring (see subpar. (1) above). Omit the alphabet ring and notch ring from the assembly. Secure with the retaining ring and check the assembly as described in subparagraph (4) above.

d. Replace the stepping unit as follows:

- (1) Tilt the stepping unit backwards at approximately a 45-degree angle and engage the slots in the stepping unit blocks with the mounting blocks on the base of the cipher machine. Make certain that the rotor stepping crank (fig. 30) fits into the yoke of the drive link assembly (fig. 29) and lower the unit into place.
- (2) Tighten the two screws assemblies finger tight. Then, engaging the handle of each screw assembly in its ratchet, twist until the rotor stepping unit is securely locked into position.

*Note:* Unless the unit is properly fastened, vibrations caused by normal operation of the machine will loosen the stepping unit sufficiently to cause erratic operation.

e. Reassemble the cipher unit as follows:

- (1) Replace the rotors in the same sequence as when removed. Insert each rotor into the cipher unit so that the pressure contacts face the open end of the housing. The stationary rotor is always the fourth rotor to be inserted.
- (2) Check to see that the latch on the right-end plate is in its forward position, and then remount the right-end plate to the cipher unit. Press the end plate against the rotors until the latch can be pushed into the slot in the rotor shaft, thereby locking the assembly.
- (3) Insert the cipher unit into the stepping unit. The guide plate (fig. 30) on the stepping unit frame insures correct insertion.
- (4) Latch the cipher unit to the stepping unit as follows:
  - (a) With the heel of the hand, press down firmly on the cipher unit. While maintaining this pressure, use the free hand to apply vertical pressure on one of the latch handles and, with a swinging motion, secure this latch. When the latch engages correctly, a certain tautness will be felt in the handle.
  - (b) Repeat for the other latch.

~~CONFIDENTIAL~~

ORIGINAL



~~CONFIDENTIAL~~

KAM-1/TSEC

## 7200—GENERAL INFORMATION FOR TRAINED MAINTENANCE PERSONNEL

## 7201. General.

- a. *References.*—It should be observed that this section is for maintenance men only and should not be referred to by operating personnel.
- b. *Introduction.*—The cleaning, lubrication, and inspection work should be confined to the items specified, except for the correction of any condition noted, not mentioned herein, which is likely to cause trouble before the next regular maintenance period.
- c. *Authority.*—The maintenance man must obtain the necessary authority for release of the equipment.
- d. *Inspection.*—During the process of cleaning and lubrication, observe as far as possible, the condition of TSEC/KL-7 with respect to the following points, without dismantling or disturbing any adjustments.
- (1) Worn parts, parts out of place, and parts obviously out of adjustment and likely to cause trouble should be readjusted or replaced.
  - (2) Take particular care in the lubrication of parts which are not worn sufficiently to warrant replacement. Be sure that lubricant gets on the bearing surfaces.
  - (3) Rust deposits should be examined; if necessary, the part should be replaced. If the parts are not corroded sufficiently to warrant replacement, remove the rust with care and put a thin coating of lubricant on the part.
  - (4) Parts which appear to be bent or springs which seem distorted should be investigated and replaced if found to be abnormal. *Do not elongate or cut a spring to adjust the tension; replace the spring.*
- e. *Tools and Materials.*—The following cleaning and lubricating tools and materials are recommended for TSEC/KL-7.
- (1) Sashbrush-type cleaning brush. Part No. CE 87291.
  - (2) Toothbrush-type cleaning brush. Part No. CE 87292.
  - (3) Cleaning block assembly, with CE 87299 web strap. Part No. CE 87293.
  - (4) Eraser. Part No. CE 87296.
  - (5) Lubricants as follows:
    - (a) Quietone<sup>NONFLAMMABLE</sup>, 8-ounce can. Part No. CE 87297.
    - (b) Stano-Drip Oil, 8-ounce can. Part No. 87282.
    - (c) Molyhube 50, 8-ounce can. Part No. CE 87283
  - (6) Cloth, Twilljean (or any lint-free cloth). Part No. CE 87298.
  - (7) Web strap for CE 87293 cleaning block assembly. Part No. CE 87299.
  - (8) Oiler, one-drop. Part No. 100688.
  - (9) Orange stick. Part No. CE 852.
  - (10) Small cleaning brush. Part No. CE 14685 or CE 87474.
  - (11) Crocus cloth. Part No. CE 853.
  - (12) Contact burnisher. Part No. 88993.
  - (13) Bond paper (standard typewriter bond, cut into strips approximately 3-inches long by ½-inch wide).
  - (14) Carbon tetrachloride (or cleaning solvent as prescribed by the Service).

**WARNING: CARE SHOULD BE EXERCISED IN THE USE OF CARBON TETRACHLORIDE AS A CLEANING AGENT. ALTHOUGH THIS SOLVENT IS NONINFLAMMABLE AND NONEXPLOSIVE IT MAY PRODUCE SEVERE TOXIC EFFECTS. ITS VAPOR**

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

IS HEAVIER THAN AIR AND CONSEQUENTLY SETTLES IN CONFINED PLACES THAT ARE NOT WELL VENTILATED, RESULTING IN DANGER OF SUFFOCATION TO ANYONE EXPOSED TO IT. FOR CLEANING ELECTRICAL CONTACTS ONLY A SMALL AMOUNT OF CARBON TETRACHLORIDE IS REQUIRED. THIS CONTAINER SHOULD BE KEPT COVERED EXCEPT WHEN ACTUALLY MOISTENING CLOTH OR WASHING PARTS.

*Note:* Quietone and Kleenlube are both furnished under one stock number, CE 87297. They should not, however, be mixed. If the lubricant used is changed, rinse rotors thoroughly with a cleaning fluid such as alcohol (FSN-6810-222-2372). Another acceptable lubricant, but one that is procured locally, is Quietrole. The stock number for Quietrole is CE 90991.

(Change No. 2 to KAM-1/TSEC, 15 May 1958)

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

**7300—CLEANING PROCEDURES FOR TRAINED MAINTENANCE PERSONNEL**

**7301. General.**—The procedures outlined below are to be followed during the cleaning processes.

- a. *Flat Head Contacts.*—Thoroughly clean flat head contacts and those contacts on the sliding contact board with an eraser. On contacts where friction is a consideration (rotors and the cipher unit right-end plate), apply a generous coating of Quietone not only to the contacts but to the closely ground surface surrounding the contacts as well. On a rotor core this area comprises the nonglossy section of the bakelite. As a rule of thumb, apply three coatings of Quietone to the area thus described to assure a "generous" application. Spread the Quietone evenly after each application and allow it to dry.
- b. Clean the pressure contacts by polishing them with a canvas cleaning block. Do not apply lubricant of any sort to the pressure contacts.
- c. For cleaning parts not readily accessible, use Twilljean cloth wrapped around an orange stick.
- d. Clean contact burnisher with Twilljean cloth, moistened in carbon tetrachloride. Avoid touching it after cleaning since perspiration and oil from the hands are detrimental to satisfactory burnishing of the contacts.
- e. When it is necessary to clean contacts not having build-ups or pits, draw a piece of clean bond paper between the contacts to remove particles of foreign matter. Insert a clean burnisher blade between the contacts and rub it back and forth, always keeping it parallel to the contact surfaces. Visual inspection will determine when the contacts are clean. *Do not use crocus cloth on electrical contacts.*
- f. When pits or build-ups are small, remove them with a burnisher as described in subparagraph e above. If they are too large to remove in this manner, replace the part.

**7302. Preparation for Cleaning.**—Before proceeding with any cleaning of TSEC/KL-7, disconnect the machine from its power source. Then, after following instructions listed in either subparagraph a or b below, proceed with the cleaning procedures.

- a. Remove the machine from its carrying case by depressing its two stop pins. If necessary, clean the case with Twilljean cloth moistened in cleaning solvent.
- b. If the machine is being operated in an office case, remove the four screws from the bottom which secure the machine to the case. Then, remove the machine. Unscrew the four captive screws on the power converter and remove the power converter from the case.

**7303. Cipher Unit.**

- a. Unlatch the cipher unit and remove it from the stepping unit. A guide plate on the stepping unit insures against damage to the pressure contacts while the unit is being removed or inserted.
- b. Remove the right-end plate from the cipher unit by snapping its latch forward. Take care that the rotors do not spill out.
- c. Tilt the cipher unit in such a manner as to permit the eight rotors to slide off their shaft, noting the sequence in which they are removed so that replacement can be made in the same order.
- d. Clean and lubricate the cipher unit as follows:
  - (1) Clean the flat head and pressure contacts on the left-end plate.
  - (2) Clean and lubricate the flat head contacts on the face of the right-end plate. Clean the flat head contacts on the bottom of the end plate.
- e. Clean and lubricate each of the eight rotors as follows:
  - (1) Clean the pressure contacts.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (2) Clean and lubricate the flat head contacts.

*Note:* <sup>CLEAN AND LUBRICATE THE CIPHER UNIT SHAFT USING STAND-DROP OIL OR</sup> Cleaning of the rotors other than that specified in subparagraph e above is not necessary unless excessive dirt or grime is present. Should such conditions exist, however, proceed as instructed in subparagraph f below. <sup>QUIET-ROLE</sup>

- f. When necessary, disassemble and clean individual rotors as follows:

- (1) Note the relative positions, by index marks, of the alphabet ring to the rotor core and of the notch ring to the alphabet ring.
- (2) Remove the retaining ring.
- (3) Remove the notch ring.
- (4) Separate the rotor core from the alphabet ring.

*Note:* To disassemble the stationary rotor, remove the retaining ring; then separate the stationary ring from the core.

- (5) Clean the rotor with dry Twilljean cloth. Clean the pressure contacts. Clean and lubricate the flat head contacts.
  - (6) Clean the notch ring with dry Twilljean cloth.
  - (7) Clean the alphabet ring with dry Twilljean cloth.
- g. Remove the left-end plate from the shell and clean the shell.
- h. Slide out the cipher unit window from the right side of the window frame. Clean the window and then replace it in its frame.
- i. Remove the left-end plate cover.
- (1) Clean the left-end plate with dry Twilljean cloth.
  - (2) Remove the two retaining rings and the rotor shaft from the left-end plate. Clean the rotor shaft.
  - (3) Clean the left-end plate with a dry Twilljean cloth.
  - (4) Clean the pressure contacts with a canvas cleaning block.
  - (5) Clean and lubricate the flat head contacts.
  - (6) Clean the wiring with the small sashbrush-type cleaning brush.

#### 7304. Rotor Stepping Unit.

- a. To remove the stepping unit from the contact panel, unlock the two screw assemblies by twisting their handles in a counterclockwise direction. Once unlocked, the screws may be completely loosened by hand. Remove the stepping unit from the contact panel by lifting upward and slightly towards the front of the cipher machine.
- b. Turn the stepping unit upside down and remove the bottom cover. Clean the cover.
- c. Remove the counter link by removing its link pins at both ends. Clean the counter link.
- d. Remove the wiring harness together with the two reentry contact blocks, the seven rotor stepping magnets, the center contact block assembly, and the actuator switch assembly as follows:

**CAUTION: TAKE CARE NOT TO BREAK ANY OF THE SOLDERED CONNECTIONS ON THE WIRING HARNESS.**

- (1) Rotate the rotor stepping drive shaft to its full forward position. With the stepping unit right side up, remove the four screws that hold the actuator switch assembly to the frame.
- (2) Turn the unit upside down and unfasten the two reentry contact blocks by removing the screws that hold them to the frame.
- (3) After removing the KLA-7/TSEC name plate, remove the two screws that hold the center contact block.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (4) Remove the two screws and the single mounting plates that hold each of the seven magnets to the stepping unit.
  - (5) *Gently* lift the wiring harness and its associated parts from the stepping unit.
- e. Remove and clean the actuator spring.
  - f. Clean the contact surfaces of the seven stepping magnets by drawing a strip of bond paper between the core and armature of each magnet, while holding the armature *lightly* against the magnet core.
  - g. Clean the pressure contacts on the two reentry blocks.
  - h. Clean the flat head contacts on the center contact block.
  - i. Clean only the outer surface of the counter. Do not disassemble it.
  - j. Turn the stepping unit rightside up and remove the four mounting screws which hold the set key assembly in place. Remove the set key assembly. Next, remove the two setscrews from the underside of the plate and pull the two rods from the assembly. This will permit the seven set keys to fall free.
  - k. Clean the set key plate, rods, and set keys.
  - l. Remove the plungers, springs, and sleeves. If necessary, push out the sleeves from the underside of the unit. Clean these components.
  - m. Remove the rotor stepping drive shaft and seven hold-down springs from the unit as follows:
    - (1) Rotate the drive shaft until its cams are in the rearmost part of their travel arc.
    - (2) Unhook the seven hold down springs from the drive linkage assemblies and back each spring and stud out of the frame. *Do not remove the springs from their studs.*
    - (3) Completely remove the screw and washer from the right end of the rotor stepping drive shaft. Remove the washer from the screw, replace the screw in the end of the shaft, and turn it in until the head is about  $\frac{1}{8}$  inch from the end of the shaft. Now tap the screw *lightly* with a hammer to free the bearing at the opposite end of the shaft from the frame. When it is loose, pull the shaft and bearing out from the right end of the frame.
  - n. Clean the seven hold-down springs and studs.
  - o. Clean the rotor stepping drive shaft, *taking care not to permit cleaning solvent to enter the sealed ball bearings.* If it is necessary to disassemble the drive shaft further, proceed as follows:
    - (1) Remove the two setscrews that bind the bearing shafts to the main shaft.
    - (2) Pull out the bearing shafts, picking off the roller bearings. Repeat for the other bearing shaft.
  - p. Remove the drive linkage shaft, the two drive linkage collars, the seven drive linkage assemblies and positioning arm as follows:
    - (1) From the top of the stepping unit frame, remove the setscrew and spring which load the positioning arm.
    - (2) From the left and right end frame, remove the two screws which bind the drive linkage shaft.
    - (3) Turn the unit upside down, and loosen the setscrew in each of the drive linkage collars.
    - (4) Wedge a toothbrush handle between the right-hand collar and the right side of the frame to prevent the drive linkages from being moved with the shaft, thus avoiding damage due to the strain of the drive pawls.
    - (5) *Slowly* pull the drive linkage shaft out through the right side of the frame, picking off the collars, drive linkages, and positioning arm.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- q. Clean the drive linkage shaft, positioning arm, two collars, and the spring used to load the positioning arm.
- r. Clean the drive linkage assemblies by immersing in cleaning solvent, if available.
- s. Remove the two latches from the stepping unit by removing each of their two mounting screws.
- t. Clean the frame and actuators using a sashbrush-type cleaning brush that has been immersed in cleaning solvent.

**7305. Printer Unit.**

**CAUTION: WHEN HANDLING THE PRINTER UNIT, DO NOT GRASP SUCH PARTS AS THE PRINT MAGNET, CAM SWITCHES, TRIP MAGNET, OR ANY OTHER COMPONENT THAT HAS SOLDERED CONNECTIONS OR DELICATE ADJUSTMENTS. GRASP ONLY THE HOUSING.**

- a. *General.*—Remove the printer from the contact panel by loosening its four captive screws. Remove the screw that secures the dust cover to the bottom edge of the front end bell and remove the rubber dust cover. Reinsert the screw so that the plug does not drop out. Remove the screw and washers which secure the dust cover to the right side of the controller cover. Work this dust cover free from the printer assembly housing. Remove the ribbon dust cover.
- b. *External Parts.*
  - (1) Release the spring assembly from the drive link by removing the retaining ring and clevis pin.
  - (2) Remove the roll of paper tape from the paper tape container and then remove the two screws that secure the container to the gear housing. Clean the tape container with dry Twilljean cloth.
  - (3) Loosen the nut that secures the dust cover on the right side of the pulse generator. Press down on the loosened nut and work the dust cover free from the housing.
  - (4) Pry the dust cover which is located over the tape feed mechanism loose from the top and remove from the printer.
  - (5) Remove the screw and washers which secure the dust cover to the left side of the controller cover. Work this cover free from the printer assembly housing.
  - (6) Remove the drive link assembly from the crankpin after first removing the retaining ring. Clean the drive link assembly, *but take care not to permit cleaning solvent to enter the sealed ball bearing.*
  - (7) Remove the print magnet from the front end bell as follows:
    - (a) Remove the retaining ring that secures the print magnet eccentric. Remove the eccentric.
    - (b) Remove the two mounting screws that secure the print magnet assembly to the front end bell and remove the print magnet assembly.
  - (8) Clean the print magnet as follows:

**CAUTION: WHEN WORKING WITH THE PRINT MAGNET ASSEMBLY TAKE CARE NOT TO DAMAGE THE REEDS. THE PRINT HAMMER IS GROUND TO FIT THE CURVATURE OF THE FIGURED WHEEL AND DAMAGE WILL DESTROY THE ALIGNMENT.**

- (a) Clean the print magnet assembly with a sashbrush-type cleaning brush.
- (b) Clean the pressure contacts.
- (c) Clean the contact surfaces by drawing a strip of bond paper between the armature and the magnet core while holding the armature *lightly* against the core.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (d) Clean the face of the hammer with Twilljean cloth moistened in cleaning solvent.
- (9) Remove the inked ribbon. If the ribbon is worn out, clean only one spool and discard the other with the old ribbon.
- (10) To remove the figured wheel, use the special spanner wrench, part No. CE 87494, and a  $\frac{3}{16}$ -inch socket wrench.

*Note:* To avoid readjusting the figured wheel, do not disturb the three binding screws on the wheel. Should it be necessary to disassemble the figured wheel, however, reassembly will require that the hub be set into the wheel so that the hub slots are centered over the wheel holes. This can be accomplished in only one of the three possible positions since both the holes and the slots are offset. When correctly positioned, the desired figured wheel adjustment is approximated and the binding screws are free to move in either direction. Then, following procedures outlined in paragraph 6336, adjust the figured wheel correctly.

- (11) Clean the figured wheel and associated parts with a toothbrush-type cleaning brush which has been immersed in cleaning solvent. *Clean the characters thoroughly.*
- (12) Remove the paper tape feed roll from its drive shaft by means of its retaining ring. Note that the feed roll follower spring is tensioned against the feed roll.
- (13) Clean the paper tape feed roll with a toothbrush-type cleaning brush.

#### 7306. Front End Bell Cover Assembly and Attached Parts.

- a. Remove the retaining ring that holds the tape feed follower, and then remove the follower, taking care not to damage the spring.
- b. Remove the three screws and lock washers that hold the front end bell cover.
- c. Using a blunt edge tool, bend the tap on the lock washer located on the right reel drive gear. Remove the gear, break washer, and compression spring from the assembly by unscrewing the hex-head mounting screw. To hold the reel drive assembly while unscrewing this screw, use the tabbed end of the CE 87494 spanner wrench. Next, remove the right reel drive gear.
- d. Clean the components of the reel drive assembly with a sashbrush-type cleaning brush immersed in cleaning solvent. Be meticulous about removing old grease from gears.
- e. Remove the ribbon reversing mechanism from cover pilot bushing. Disassemble the unit by removing its retaining ring from the back of the bushing so that the components separate.
- f. Clean the front and rear ring gears and ribbon drive gear in the same manner as described in subparagraph *d* above.
- g. Following procedures outlined in subparagraphs *c* and *d* above, remove and clean the left reel drive assembly.

#### 7307. Pulse Generator Assembly.

**CAUTION: DO NOT DISASSEMBLE THE STATOR AND END BELL ASSEMBLY. THE ALIGNMENT BETWEEN THE ROTOR AND STATOR IS A VERY CRITICAL ADJUSTMENT WHICH INSURES PULSE HEIGHTS OF CORRECT MAGNITUDE. DISASSEMBLY OF THE STATOR AND END BELL ASSEMBLY MAY DISTURB THIS ALIGNMENT.**

- a. Remove the tape feed roll drive shaft and associated parts from the front end bell as follows:
  - (1) Remove the two screws and lock washers which secure the support of the stator and end bell assembly. *Take care not to damage any of the wiring.*
  - (2) Remove the single-drive and double-drive ratchet pawl springs from their hook stud. Remove the no-back pawl spring from its hook stud.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (3) Remove the nut and lock washer from the threaded rear portion of the tape feed roll drive shaft.
  - (4) Pull the tape feed roll drive shaft through the front end bell bushing. After manually disengaging the stop pawl, pull the shaft toward the front, picking off the single-drive ratchet assembly, the stop ratchet, and double-drive ratchet assemblies.
  - (5) Remove the compression spring which joins the double-drive ratchet assembly to the stop ratchet assembly and separate the two ratchets.
- b. Remove the yoke assembly from the front end bell as follows:
- (1) Loosen (but do not remove) the screw and plug in the bottom edge of the front end bell.
  - (2) Using the CE 87402 wrench, remove the threaded pivot screw from the yoke assembly. This wrench is a special type wrench designed expressly for the threaded pivot screw on the yoke. It is so designed that with its handle in any given position, its sockets can be engaged in any one of three different positions.
  - (3) After removing the threaded pivot screws from the yoke, slip the yoke free of the tape and ribbon drive shaft eccentric and remove the bushing from the yoke.
 

*Note:* For purposes of cleaning and lubrication it is not necessary to remove the pawls on the pawl shaft. Doing so will disturb the double drive ratchet effective length adjustment. For replacement purposes, however, the instructions outlined in subparagraphs (4), (5), and (6) below describe the method of disassembly.
  - (4) After loosening the screw and plug in the front end bell, remove the retaining ring and flat washer that secures the single-drive ratchet pawl to its shaft. Remove the pawl.
  - (5) Remove the two setscrews in the double-drive ratchet eccentric. Next remove the double-drive ratchet pawl eccentric and the double-drive ratchet taking extreme care not to damage the pawl shaft.
  - (6) Using a  $\frac{3}{16}$ -inch wrench (or the CE 87402 wrench), remove the threaded pivot screw from the yoke assembly. Slip the yoke free of the tape and ribbon drive shaft eccentric and remove the bushing from the yoke.
- c. Do not remove the tape and ribbon drive shaft from the stator and controller assembly. If so done, damage may result to the shaft because of the tight fit in both front and rear end bell bushings. For cleaning and lubricating purposes, it will suffice to push the shaft only part way out of the front end bell towards the rear end bell.
- d. Do not remove the bracket or its associated parts from the front end bell for cleaning and lubricating purposes. If so done, the no-back pawl adjustment will be disturbed. However, should it be necessary to disassemble for replacement purposes, the following steps should be taken:
- (1) Remove the stop pawl spring from its anchoring hole.
  - (2) Remove the nut and lock washer which hold the shaft to the front end bell.
  - (3) Remove the no-back pawl and the no-back pawl eccentric from their pawl shaft, taking care not to damage the shaft.
  - (4) Separate the no-back pawl from its eccentric.
  - (5) Remove the stop pawl from its shaft.
  - (6) From the slotted end of the shaft, unscrew the shaft from the front end bell assembly.
  - (7) Remove the pivot screw and the lever from the bracket assembly casting.
  - (8) Remove the screw which holds the bracket assembly to the front side of the front end bell.
  - (9) Remove the bracket casting from the front end bell, taking care not to break the casting.
- e. Clean the components on the front end bell as follows:
- (1) Immerse all components removed in subparagraphs a and b above in cleaning solvent.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

- (2) Clean the tape and ribbon feed drive shaft with a Twilljean cloth moistened in cleaning solvent.
  - (3) Clean parts remaining on stop and no-back pawl shaft with Twilljean cloth moistened in cleaning solvent.
- f. Remove the helical gear and pinion assembly from the pulse generator rotor, after first removing the nut and lock washer.

*Note:* In some machines, the helical gear and pinion assembly is held in place by a retaining ring.

- g. Clean the old grease from the helical gear and pinion assembly by immersing the assembly in cleaning solvent and wiping dry with Twilljean cloth. Do not permit assembly to soak in solvent.
- h. Clean the pressure contacts on the pulse generator assembly.

*Note:* See paragraph 8201 for more detailed procedures concerning the C.E. 87383 Stator and End Bell Assembly.

#### 7308. Motor-Generator and Controller Assembly.

- a. Remove the motor-generator and controller from the gear housing by means of the four screws and lock washers.
- b. Clean the motor-generator gear, taking care to remove old grease.
- c. Separate the controller from the motor by removing two screws. Also remove the end cover from the motor.
- d. Remove the negative (top) and positive (bottom) brush assemblies. Note that their respective markings are marked on the sides.
- e. Clean the brush assemblies with Twilljean cloth moistened in cleaning solvent.
- f. Holding a Twilljean cloth moistened in cleaning solvent against the commutator, rotate the motor armature by hand and clean the commutator.

**CAUTION: DO NOT USE A METAL INSTRUMENT TO CLEAN THE COMMUTATOR BECAUSE SCRATCHES WILL IMPAIR OPERATION OF THE MOTOR.**

- g. Remove the controller cover and insulator assembly from the controller panel by the remaining screw and lock washer. (The other two mounting screws, lock washers, and flat washers were removed with the dust covers.) Do not disassemble the controller assembly further.
- h. Using a sashbrush-type cleaning brush, clean the electrical components of the controller assembly. Take care not to change the position of the tap on the adjustable resistor.

**CAUTION: SERIOUS DAMAGE TO THE MOTOR MAY RESULT IF THE TERMINALS OF THE NEGATIVE COEFFICIENT RESISTOR ARE DAMAGED.**

- i. Remount the controller cover and insulator assembly on the controller panel.

*Note:* See paragraph 8202 for more detailed disassembly of Motor-Generator and Controller Assembly.

#### 7309. Timing Unit.

- a. Remove the four screws and lock washers that hold the timing unit to the gear housing and pull the timing unit free.
- b. Clean the timing shaft miter gear and helical gear, taking care to remove all old grease. Do not get cleaning solvent in either the timing shaft front bearing or the clutch drive bearing.
- c. Clean all the accessible parts of the timing unit with a dry Twilljean cloth.
- d. Remove the contact block with the cam switches and the trip magnet assembly from the housing as follows:
  - (1) Remove the trip magnet armature from the magnet by lifting up on the retaining spring.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (2) Remove the center trip magnet adjusting screw from the bracket which is located on the side opposite the armature.
- (3) Remove the contact block and cam switch assembly from the housing by means of the four screws, lock washers and spacers. Take care that the fragile wiring on this assembly is not broken. *Do not disassemble the cam switch assemblies.*
- (4) Draw the trip magnet free from the right side of the housing.
- e. Clean the contacts of the cam switch assemblies by drawing a strip of bond paper between them.
- f. Clean the pressure contacts.
- g. Clean the contact block using a dry Twilljean cloth and dry sashbrush-type cleaning brush. Take care not to damage the electrical connections.
- h. Clean the trip magnet assembly with cleaning solvent, but do not let solvent get on cores. Clean contacts on the cores with a dry Twilljean cloth.
- i. Clean the armature assembly using a canvas cleaning block on the brass contacts.
- j. Unhook the detent pawl spring from its post.
- k. Remove the detent pawl from the housing as follows:
  - (1) Unhook the detent pawl spring from its post.
  - (2) Loosen the setscrew that secures the eccentric stud.
  - (3) Using some sort of small wedge-like device, work the eccentric stud free from the housing.
  - (4) Remove the detent pawl and the spring.
- l. Clean all items removed in subparagraph *k* above.
- m. Remove the timing shaft and component parts as follows:

*Note:* The timing shaft and clutch assembly are noninterchangeable and if replaced must be replaced together. (See part No. CE 87330 for part information.) The tolerances necessary in splining the clutch to the timing shaft so that the clutch pawl properly engages the trip magnet are too critical to be disturbed.

- (1) Remove retaining ring from rear end of timing shaft.
- (2) Work spacer free from the housing. If necessary, tap it free.
- (3) Slide the timing cam and compression spring off the shaft.
- (4) Slide the clutch assembly back on the shaft to gain access to the retaining ring that secures the timing shaft. Remove the retaining ring and pull out the timing shaft from the front. Take care not to drop the clutch assembly.
- (5) Using CE 14690 Waldes Kohinoor pliers, remove the retaining ring located on the hub of the clutch drive assembly from the clutch drive assembly ball bearing. Tap out the unit, using a soft-faced hammer or wood block to avoid damage to the gears.

*Note:* Do not lose the spacer on timing shaft. This spacer determines the correct relationship between the miter gears on the timing shaft and crankshaft.

- (6) Immerse the clutch in cleaning solvent and dry with Twilljean cloth.
- (7) Clean the timing shaft, spacer, phenolic timing cam, and spacer assembly with a dry Twilljean cloth.
- (8) Clean the clutch drive assembly, removing old, hardened grease from the ratchet. Take care that cleaning solvent does not penetrate the seal, oil ring, or the timing shaft unsealed ball bearing. Note that it is not necessary to remove these parts (the seal, oil ring, and ball bearing) to clean the clutch drive assembly.
- (9) Remove the clutch drive bearing from the timing unit housing by means of the retaining ring.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (10) Clean this bearing only with a dry Twilljean cloth. Do not use cleaning solvent as it may enter the bearing.
- (11) Immerse the housing in a container of cleaning solvent.

**7310. Crankshaft Assembly.**

- a. Remove the crankshaft assembly from the gear housing by means of its two binding screws.
- b. Remove the two screws that bind the crankshaft assembly to the gear housing and work the crankshaft free from the housing. Note the number of shims used between the housing and the assembly so that when reassembling the correct backlash adjustment can be reestablished.
- c. Clean the crankshaft miter gear, removing old grease. Clean the crankshaft and the ball bearing with a dry Twilljean cloth.
- d. Immerse the gear housing in a container of cleaning solvent.

**7311. Keyboard Assembly.**

- a. Remove the five screws which attach the keyboard to the base assembly.
- b. Loosen the two setscrews in the selector handle and remove it.
- c. Remove the nut, the indicator plate, and the housing assembly from the key chassis.
- d. Clean the key chassis and rail assembly with attached parts by moistening a cloth with cleaning solvent and removing accumulated dirt. In places not readily accessible, use the small sashbrush-type cleaning brush dipped in cleaning solvent.

**CAUTION: KEEP CLEANING SOLVENT AWAY FROM THE SPACE BAR PRESSURE CONTACT AND THE KEY SWITCHES.**

- e. Using the small sashbrush, clean around the power switch, the space bar, and lug assemblies.
- f. Using the canvas cleaning block, clean all key switch contacts, power switch leaf contacts, and the space bar pressure contact. To avoid damage to the power switch leaves, support them firmly.
- g. Remove the retaining ring and remove the retainer with radius arm attached from the housing. Clean these parts by immersion in cleaning solvent. Wipe dry with a piece of Twilljean cloth.

**CAUTION: TAKE PAINS NOT TO LOSE THE BEARING BALLS AND SPRING IN THE RETAINER WHEN REMOVING THE RETAINER. THE SPRING AND BALLS WILL JUMP OUT UNLESS HELD IN PLACE.**

**7312. Sliding Contact Board and Guide Rail Assembly.**

- a. Clean the guide rail and rollers with a Twilljean cloth moistened with cleaning solvent. Dry these parts with a Twilljean cloth.

**CAUTION: DO NOT ALLOW CLEANING FLUID TO GET ON THE SLIDING CONTACTS.**

- b. Clean the sliding contact board with a dry Twilljean cloth. Clean all of the flat head contacts.

**7313. Contact Panel Assembly.**

- a. Loosen the six screws and lock washers which fasten the contact panel assembly to the base assembly. Lift the contact panel assembly from the base assembly.

**CAUTION: IN HANDLING THE CONTACT PANEL ASSEMBLY, GRASP IT BY THE ENDS. BE CAREFUL NOT TO EXERT ANY PRESSURE ON THE ELECTRICAL COMPONENTS MOUNTED ON THE UNDER**

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

SIDE. EXERT NO LATERAL PRESSURE ON THE EXPOSED TIPS OF THE PRESSURE CONTACTS. WHEN PLACING THE ASSEMBLY FLAT ON A TABLE OR BENCH, SUPPORT IT NEAR THE FOUR CORNERS SO THAT THE ELECTRICAL COMPONENTS OR THE PRESSURE CONTACTS WILL NOT REST UPON THE TABLE OR BENCH TOP. AS AN ALTERNATIVE, THE CONTACT PANEL ASSEMBLY MAY BE MOUNTED ON A CE 87052 TEST BASE.

- b. Clean the top surface of the contact panel with a small sashbrush, removing all dirt in areas between adjacent pressure contacts.
- c. Clean the pressure contacts with a canvas cleaning block.
- d. Clean the flat head contact surfaces.
- e. Clean the bottom of the contact panel with a small sashbrush, taking care not to damage electrical wiring connections.
- f. Remove the retaining ring from the follower. Remove the follower and spring from the follower block. Clean the follower and spring with a Twilljean cloth.
- g. Clean the lamp socket canopy with a Twilljean cloth.

**7314. Base Assembly.**—Remove the two screws, the spring retainer, and the spring for both stop pins. Withdraw each stop pin from an insert in the base. Clean the parts just removed. Clean the stop pin inserts with Twilljean cloth wrapped on an orange stick. Clean all surfaces of the base.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

**7400—LUBRICATING PROCEDURES FOR MAINTENANCE PERSONNEL****7401. General.**

- a. After all cleaning, inspection, and replacements have been accomplished, lubricate and re-assemble the TSEC/KL-7 cipher machine in the sequence listed in the paragraphs which follow:
- b. Special care should be taken to lubricate thoroughly surfaces which indicate wear.
- c. Place a drop of oil on all helical springs. To determine proper spring tension, refer to chapter 6, MECHANICAL ADJUSTMENTS.
- d. Unless otherwise specified, apply one or two drops of oil at each of the points mentioned.
- e. After assembly, remove all excess oil or grease from the components.
- f. Do not lubricate a plastic, phenolic, or nylon part.
- g. Flat head contacts are to be cleaned and lubricated as described in paragraph 7102. Do not apply a lubricant of any sort to pressure contacts.

**7402. Lubricants.**—Refer to subparagraph 7201e(5) for list of recommended lubricating materials.

**7403. Base Assembly.**—Apply a thin film of Molylube to the stop pins, then replace the stop pins, springs, spring retainers, and four screws.

**7404. Contact Panel Assembly.**—Apply a thin film of Molylube to the follower. Replace the contact panel assembly on the base assembly. Replace follower in contact panel.

**7405. Sliding Contact Board and Guide Rail Assembly.**—Oil each roller pin.

**7406. Keyboard Assembly.**

- a. Lubricate the following parts of the selector handle assembly as instructed.
  - (1) Bearing balls—oil.
  - (2) Spring—oil.
  - (3) Internal surface of housing—oil, light film.
- b. Clevis pins which secure space bar to key chassis—oil.
- c. Key switches—Molylube, thin film.

**CAUTION: WIPE EXCESS MOLYLUBE FROM KEY SWITCH CONTACTS.**

- d. Assemble the selector handle assembly as follows:
  - (1) Insert spring and bearing balls in retainer, and holding the balls in place, slip retainer back into the housing.
  - (2) Secure the retainer in the housing with a retaining ring.
  - (3) Mount the housing assembly and indicator plate on the key chassis and secure with the nut.
  - (4) Set the selector handle on the retainer shaft so that the two setscrews fit correctly on the shaft flats. Tighten the setscrews.
- e. Reassemble the keyboard and sliding contact board and guide rail assemblies as follows:
  - (1) Turn the selector handle on the keyboard to the D position.
  - (2) Back each of the five captive screws into the keyboard assembly until their threads are engaged.
  - (3) Set the sliding contact board and guide rail assembly, guide rails face up, onto the contact board so that the follower cam is to the left of the follower (in D position).

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (4) Lower the keyboard into position so that the five captive screws set down into their standoffs. If correctly done, the keyboard will slip into its correct position and the groove will fit over the follower assembly.
- (5) Securely tighten the five captive screws and then move the selector handle through its four positions to insure that the selector handle radius arm is properly engaged with the sliding contact board.

**7407. Printer Assembly.****a. Crankshaft Assembly.**

- (1) Miter gear teeth—Molylube, thin film.
- (2) Remount the crankshaft on the gear housing by means of the two screws. Use the same number of shims as before unless components in the timing unit (see subpar. 7309m) have been changed.

**b. Timing Unit.**

- (1) Install the clutch drive bearing in the housing assembly and secure with the retaining ring.
- (2) Lubricate the following as instructed:
  - (a) Saturate the oil ring in the clutch drive assembly by immersing the hub section of the clutch drive assembly in a container of oil. Wipe off excess oil.

*Note:* Replacement of the seal or oil ring is not advisable unless absolutely necessary. Even then, unless proper tools are available, it is better to replace the entire assembly. The only manner in which these components may be removed is by tapping out the timing shaft bearing from the hub-side of the clutch drive assembly which usually necessitates replacement of the bearing.

- (b) Clutch drive ratchet teeth—Molylube.
  - (c) Timing shaft—oil, thin film.
  - (d) Clutch pawl pivot pin—oil, thin film.
  - (e) Surface of clutch pawl carrier where detent pawl sits—Molylube, thin film.
- (3) Install timing shaft as follows:
    - (a) Remount spacer on the timing shaft if it has been removed. If a new spacer is necessary, see subparagraph (4), below.
    - (b) Insert the timing shaft in the large end of the clutch drive assembly. Fully seat the timing shaft.
    - (c) Secure the timing shaft with a retaining ring in the groove near the ratchet.
    - (d) Mount the clutch assembly on the shaft so that the clutch pawl can engage the clutch drive assembly ratchet. Hold the clutch assembly on the shaft while carrying out the following procedures:
      - (e) Tap the clutch drive assembly into the clutch drive bearing.
      - (f) Secure the clutch drive assembly with the retaining ring mounted in the groove in the hub of this assembly.
  - (4) If components have been replaced on either the crankshaft or timing unit, the correct backlash between the timing shaft miter gear and the crankshaft miter gear must be reestablished at this point.
    - (a) To check for the correct relationship between miter gears on the timing shaft and crankshaft, proceed as follows:
      1. Position the crankshaft assembly (without the shims) on the gear housing. Do not secure.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

2. Mount the timing unit on the gear housing using only two of the mounting screws and lock washers.
  3. Holding the crankshaft firmly in position, visually check the relationship between the larger diameters of the miter gears. The gears should have approximately 0.005-inch clearance.
  4. If this relationship is not correct, disassemble the unit and replace the timing shaft spacer. Use a thinner spacer to increase clearance; use a thicker spacer to decrease clearance.
- (b) To check the backlash adjustment:
1. Move the crankshaft into position on the gear housing to permit some backlash to the crankshaft pin. Measure this clearance with a feeler gage.
  2. Dismount the timing unit and crankshaft assembly from the gear housing.
  3. Mount the crankshaft assembly on the gear housing using the number of shims, the combined thickness of which equals the clearanced measured in subparagraph 1 above. Fasten the crankshaft in place with the two mounting screws.
- (5) Reassemble the remaining components of the timing shaft as follows:
- (a) Seat the clutch pawl on the clutch drive ratchet. Push the clutch assembly firmly against the clutch drive assembly.
  - (b) Remount the compression spring, the timing cam, and the spacer assembly on the shaft. Fasten in place with the retaining ring in the shaft groove located behind the spacer assembly.
- (6) Contacting edge of armature stopping lip (the armature stopping lip is formed by the outer end of trip magnet guard)—lubricate with light film of Molylube.
- (7) Trip magnet guide plate—do not lubricate.
- (8) Upper surface of knife-edge section of the armature (knife-edge is surface of armature that fits into grooves under the retaining spring when the trip magnet assembly is mounted)—do not lubricate.
- (9) Eccentric stud—lubricate with thin film of oil.
- (10) Point of detent pawl—apply thin film of Molylube.
- (11) Helical gear on clutch drive assembly—apply Molylube.
- (12) Timing shaft miter gear—apply Molylube.
- (13) Assemble the remaining components of the timing unit as follows:
- (a) Insert the trip magnet guide plate in grooves from the side with heli-coil insert. Tighten the center trip magnet adjusting screw.
  - (b) Remount the contact block on the base of the housing using four screws and lock washers and one spacer. The spacer is inserted over the rear hole on the side opposite the cam switches.
  - (c) Remount the trip magnet armature.
  - (d) Remount the detent pawl; assemble it in its slot on the timing unit housing. Hold in position while tapping the eccentric stud into the housing. Remount the detent pawl spring. Do not tighten the setscrew.
  - (e) With the timing shaft in its stop position, the armature and clutch pawl should be nearly flush. If not, adjust in accordance with paragraphs 6309 and 6310.
  - (f) With the timing shaft in its stop position, the detent pawl should fully engage the clutch pawl carrier notch. If it does not, a clicking sound may be heard when the clutch drive is manually rotated. This is caused by the tooth on the clutch pawl

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

not clearing the clutch drive assembly ratchet. As a preliminary adjustment, turn the eccentric stud until the clutch pawl just clears the ratchet teeth, (so no clicking sound is heard when the timing shaft is rotated manually).

- (g) Check the timing unit adjustment as outlined in paragraph 6311.
  - (14) With the timing shaft in its stop position, turn the crankshaft until the groove is vertical with the pin on the left, (or, assuming full assembly of the printer unit, the groove is vertical and the pin is in its most forward position).
  - (15) Tighten the other two screws and lock washers that bind the timing unit to the gear housing.
  - (16) Check the backlash adjustment as outlined in paragraph 6302.
- c. *Motor-Generator and Controller Assembly.*
- (1) Apply Molylube to motor-generator gear teeth.
  - (2) Remount the cover and insulator on the controller with only the screw and lock washer that screws into the motor cover. The screws and washers which fit into the sides of the controller cover will be inserted with the dust covers.
  - (3) Mount motor-generator and controller assembly on gear housing using the four screws and lock washers.

d. *Pulse Generator Assembly.*

- (1) Apply light film of Molylube to tape and ribbon drive shaft spur gear.
- (2) Apply thin film of oil to tape and ribbon drive shaft bearing surface.
- (3) Bracket assembly and associated parts as follows:
  - (a) Apply thin film of oil to plunger.
  - (b) Apply thin film of oil to bearing surface of pivot screw.
  - (c) Apply thin film of oil to bearing surface of parts mounted on pawl shaft.
  - (d) Apply thin film of Molylube to pawl points.
- (4) Yoke assembly and associated parts as follows:
  - (a) Apply thin film of Molylube to the yoke.
  - (b) Apply thin film of oil to pivot bushing.
  - (c) Apply thin film of oil to single-drive ratchet pawl bearing surface.
  - (d) Apply thin film of oil to double-drive ratchet pawl bearing surface.
  - (e) Apply thin film of Molylube to tips of pawls.
- (5) Remount yoke assembly and associated parts as follows:
  - (a) Make certain tape and ribbon feed drive shaft is in the correct position.
  - (b) Insert bushing in yoke and position yoke on front end bell so that it engages tape and ribbon drive shaft eccentric. Using the CE 87402 special wrench, tighten the yoke using the threaded pivot screw previously removed.

*Note:* If pawls have been removed from the pawl shaft, proceed as instructed in subparagraphs (c) and (d) below.

- (c) Insert double-drive ratchet pawl and double-drive ratchet eccentric on the pawl shaft. Take care not to damage the shaft. Insert the two setscrews into the eccentric but do not tighten at this point.

*Note:* When printer assembly is completely assembled and remounted on contact panel, check effective length of double-drive ratchet adjustment (see paragraph 6321).

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

- (d) Remount the single-drive ratchet pawl on the pawl shaft and fasten in place with the washer and retaining ring previously removed.
- (e) Tighten the setscrew and plug in the bottom edge of the front end bell.
- (6) Tape feed roll drive shaft and associated parts as follows:
  - (a) Apply thin film of oil to tape feed roll drive shaft.
  - (b) Oil, as required, the bearing surfaces of all parts mounted on the tape feed roll drive shaft.
  - (c) ~~Apply thin film of Molylube to ring and double-drive ratchet teeth.~~
- (7) Remount tape feed roll drive shaft and associated parts as follows:
  - (a) Reassemble the double-drive ratchet on the stop ratchet bushing. Replace the compression spring which joins them together.
  - (b) Insert the tape feed roll drive shaft through the front end bell bushing. Manually disengage the stop pawl and remount the stop and double-drive ratchet on the shaft.
  - (c) Place single-drive ratchet onto the squared portion of the tape feed roll drive shaft. Make certain that the detent ratchet pawl on the single-drive ratchet engages the detent ratchet on the stop ratchet assembly and that the no-back and stop pawls can fully engage with their respective ratchets.
  - (d) Fasten the assembly using the nut and lock washer previously removed.
- (8) Apply thin film of Molylube to single- and double-drive ratchet teeth.
- (9) Apply thin film of oil to detent ratchet pawl loading lever pivot point.
- (10) Replace the no-back pawl spring on its hook stud. Replace the single-drive and double-drive ratchet pawl springs on their hook stud.
- (11) Remount support to stator and end bell assembly, using the two screws and lock washers previously removed.
- (12) Apply thin film of Molylube to helical gear and pinion assembly teeth.
- (13) Apply thin film of oil to tape and ribbon drive shaft coupling keyway.
- (14) Replace the helical gear and pinion assembly on the pulse generator rotor using the nut and lock washer previously removed.

*e. Front End Bell and Attached Parts.*

- (1) Apply thin film of Molylube to the three bushings of front end bell cover.
- (2) Apply thin film of Molylube to the left and right reel drive gear bearing surfaces.
- (3) Apply thin film of Molylube to the ribbon drive gear bearing surface.
- (4) Apply thin film of Molylube to the ribbon drive gear bearing surface.
- (5) Apply thin film of Molylube to the pivot of shifting lever.
- (6) Assemble the ribbon reversing mechanism as follows:

*Note:* The terms left and right assume the unit is being viewed from the front of the cover.

- (a) Mount one of the reel drive assemblies in the left bushing.
- (b) Mount the CE 54592 helical compression spring over the bushing, and mount the break washer over the spring.
- (c) Mount the left reel drive gear over the reel drive assembly. (Note that the left reel drive gear has the raised hub.) Mount it on back of the reel drive assembly so that its square shaped hole fits over the square shaped ridge on the reel drive assembly.
- (d) Hold the gear on the square shaped ridge by pressing with the thumb. Fasten in place with lock washer and hex-head screw. Lock with the washer tabs.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

## (e) Assemble ribbon reversing mechanism as follows:

1. Mount front ring gear on bushing so that internal teeth face retaining ring groove.
  2. Mount ribbon drive gear on bushing so that side of drive gear bushing with small diameter faces retaining ring groove. Engage scallop gear in front ring gear internal teeth.
  3. Mount rear ring gear on bushing and engage scallop gear with internal teeth. Fasten with retaining ring.
- (f) Mount right reel drive assembly, CE 87136 compression spring, break washer, and drive gear in a manner similar to subparagraphs (a) through (d) above.
- (g) Mount cover on front end bell and secure with three screws.
- (7) Work tape feed roll follower with spring into position, making certain spring tension is adequate. Fasten with retaining ring.
- (8) Apply thin film of oil to tape feed follower stud.
- (9) Apply oil at each end of the tape feed follower spring.

f. *External Parts.*

- (1) Apply light film of Molyube to surface of yoke.
- (2) Apply oil to the drive link clevis pins.
- (3) Swing the feed roll follower as far counterclockwise as possible and mount the tape feed roll (hub side faced in) onto its shaft. Push tape feed roll onto the shaft far enough to mount the retaining ring.
- (4) Place the ring and figured wheel on the pulse generator rotor shaft. Fasten with lock washer and acorn nut.
- (5) Replace the print magnet assembly on the front end bell as follows:
  - (a) Place the magnet bracket correctly on the two pins provided on the front end bell. Fasten magnet assembly to the end bell by means of the two mounting screws. Tighten the screws only finger tight. *Take care not to damage the reeds.*
  - (b) Press the print magnet eccentric firmly against the magnet bracket and fasten with a retaining ring.
  - (c) Check the print magnet eccentric adjustment as outlined in paragraph 6329, and then tighten the two mounting screws.
- (6) Remove the screw and flat washer from the left side of the controller cover. Fit the CE 54552 dust cover against the printer. Fasten the dust cover using the screw and flat washer previously removed.
- (7) To fasten the dust cover to the right side of the pulse generator area of the printer, first loosen the nut on the cover so that the catch spring has easy travel. Using a scooping-up motion, press the dust cover against the printer. Lift up on the catch spring until it is secure and tighten the nut.
- (8) Mount the paper tape container onto the printer assembly using the two mounting screws. Note that if the spring assembly was previously removed, it should be replaced before mounting the container.
- (9) Mount drive link on crankpin with yoke of link to rear and face up. Hold in place with retaining ring.
- (10) Using clevis pin and retaining ring, attach spring assembly to drive link.
- (11) Install paper tape as described in subparagraph 3003d.
- (12) Install ribbon as described in subparagraph 3003c.

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

- g. Dust Covers.*—Add the remaining dust covers to the printer as follows:
- (1) Remove the screw from the bottom edge of the front end bell and fit the low end of the bed-shaped rubber dust cover under the bracket area of the front end bell. Secure the strip by means of the screw.
  - (2) Slip the groove section of the tape feed dust cover between the captive screw and the support casting. Push down on the cover until it snaps into position.
  - (3) Remove the screw and flat washer from the left side of the controller cover. Fit the CE 54552 dust cover against the printer. Fasten the dust cover using the screw and flat washer previously removed.
  - (4) Snap the ribbon dust cover over the cover area of the front end bell.

**7408. Rotor Stepping Unit.**

- a.* Remount each of the latches on the rotor stepping frame using two screws and dowel pins for each latch.
- b.* Apply thin film of oil to drive link shaft.
- c.* Insert the drive link shaft through the left side of the rotor stepping frame, placing the collar and three drive linkage assemblies on the shaft. Set the positioning arm into position on its boss. Run the shaft through the arm and assemble the remaining four drive linkage assemblies and collar on the drive link shaft. Fasten the shaft with two flat head screws.
- d.* Apply thin film of Molylube to each of the roller bearing camming surfaces on the rotor stepping drive shaft.
- e.* Tap the rotor stepping drive shaft and bearing into the rotor stepping frame from the left side. Replace the screw and washer in the right end of the rotor stepping shaft and tighten.
- f.* Apply oil to eccentric pins.
- g.* Align the drive pawls so that they protrude through the centers of their respective openings. Lock all the drive shaft assemblies in position by tightening the setscrews in the collars.
- h.* Position the spring for the positioning arm through the hole in the top rear of the rotor stepping frame and fasten with the setscrew.
- i.* Assemble the seven hold-down springs.
- j.* Assemble the seven set keys and the set key plate with the two rods and two setscrews.
- k.* Assemble the seven sleeves, plungers, and springs. Replace the set key assembly and fasten in place with the four flat head screws.

**CAUTION: CAUTION SHOULD BE TAKEN NOT TO DAMAGE THE WIRE HARNESS AND THE ASSOCIATED PARTS WHILE REPLACING THEM.**

- l.* With the rotor stepping frame inverted, place the harness and attached parts in their places.
  - (1) Fasten each of the seven stepping magnets with two screws and the stepping magnet mounting plate.
  - (2) Slide the actuator spring and the clamping plate in place and align the actuator switch assembly.
  - (3) Holding the parts in position, and taking pains not to damage the three contact blocks or their attached wiring, invert the rotor stepping frame and fasten the actuator switch assembly with four flat head screws.
  - (4) Attach each of the three contact block assemblies to the rotor stepping frame with two screws through each block.
- m.* Oil the counter link pins.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- n. Assemble the counter link to the rotor stepping drive shaft and the counter spring with the two pins and two retaining rings.
- o. Fasten the bottom cover by means of five screws.
- p. Oil the screw assembly springs (screw assemblies secure unit to contact panel).

**7409. Cipher Unit.**

**CAUTION: NO LUBRICANT OTHER THAN QUIETONE SHOULD BE APPLIED TO ANY PART OF THE CIPHER UNIT.**

## a. Assemble the rotors as follows:

- (1) Set the alphabet ring on the rotor core so that the arrow on the core points to its correct numerical designation on the alphabet ring. Wiggle the alphabet ring to make certain the core and ring dovetail.
- (2) Set the notch ring onto the core so that the two white indicator lines correctly line up with the designated letter on the alphabet ring.
- (3) Set one ear of the retaining ring into the rotor core groove. Then, while holding this position with the thumb and forefinger of one hand, run the thumb of the other hand along the periphery of the ring, exerting continuous pressure until the ring is fully seated in its groove.
- (4) When the rotor is assembled, check the arrow and line indicators on the rotor core and notch ring to determine whether the rotor settings are correct. Then, gripping the alphabet ring with one hand and the notch ring with the other, twist in opposite directions. If the rotor is correctly assembled, there will be no slippage whatsoever.

*Note:* In the case of the stationary rotor, mount the stationary ring to the rotor core in a manner similar to that described for the alphabet ring in subparagraph (1). Omit the alphabet ring and notch ring from the assembly. Hold in place with the retaining ring and check the assembly as described in subparagraph (4) above.

## b. Assemble the cipher unit as follows:

- (1) Fit the rotor shaft into the left-end plate using the two retaining rings.
- (2) Attach the cover to the left-end plate.
- (3) Replace the cipher unit shell on the left-end plate using the three mounting screws.
- (4) In the same sequence as when previously removed, replace the first three rotors in the unit with their plunger contacts facing the open end of the housing.
- (5) Install the stationary rotor in the No. 4 position, and then install the remaining four rotors, taking care to maintain the correct sequence.
- (6) With its latch in the forward position, remount the right-end plate.

**7410. General Maintenance Checks.**—After a thorough cleaning and lubrication, the following checks and tests should be made to make sure that the cipher machine will operate properly.

- a. Check all of the adjustments as specified in chapter 6, MECHANICAL ADJUSTMENTS.
- b. Follow the tests as outlined in paragraph 3004.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## CHAPTER 8 SERVICE GUIDE

### 8000—CHECKING PROCEDURE FOR MAINTENANCE PERSONNEL

**8001. General.**—This section is for trained maintenance men only. Operators encountering troubles should refer to paragraph 3004, Test Procedures, and to the associated section on trouble shooting, section 3100. Under no circumstances should an operator exceed the scope as outlined in the aforementioned text.

**8002. Trouble-Shooting Data.**—Take advantage of the material supplied in this manual to help in rapidly locating faults. Consult the following trouble-shooting data:

- a. *Chart No. 1—Trouble Shooting TSEC/KL-7.*—This is the most inclusive of all trouble-shooting aids in this publication. It lists most of the troubles that may be experienced with TSEC/KL-7, explains their causes, and prescribes a remedy. Although the troubles have been grouped according to major components (printer, cipher unit, etc.), maintenance men should be aware that frequently a trouble will manifest itself in one component but actually be in another.
- b. *Chart No. 2—Trouble Shooting TSEC/KL-7 with the Oscilloscope.*—This chart provides a convenient means of trouble shooting the equipment where oscilloscopes are available. This chart is laid out in a manner to include a complete check of the electronic circuits of the machine.
- c. *Chart No. 3—Typical Voltage Readings.*—This is an extensive listing of voltages throughout the machine. It assumes that a CE 87052 test base assembly is available so that access to the bottom of the contact panel can be obtained.
- d. *Contact Panel Assembly Diagram (fig. 58).*—This diagram shows the location of contact terminals as viewed from the top side of the contact panel. An associated chart lists the voltages to be obtained at various points on the panel. Although not as extensive as the voltages in chart No. 3, this chart has the advantage in that the readings may be taken from the top side of the panel.
- e. *Voltage and Resistance Chart for Tube Socket Terminals (fig. 59).*—This chart lists the voltage and resistance measurements normally obtained between the common bus and tube socket terminals, using a 20,000 ohms-per-volt meter. The chart is intended to help locate defective parts associated with the electronics circuit of TSEC/KL-7. Because of normal variations in the electrical values of individual parts, readings may differ somewhat from those listed. However, if the difference is large, the parts and wiring connected to that terminal should be tracked back and checked with the meter until the trouble is found.

**CAUTION: TO AVOID DAMAGING THE TEST METER, DISCONNECT TSEC/KL-7 FROM ITS POWER SOURCE BEFORE MAKING RESISTANCE MEASUREMENTS.**

- f. *Complete Schematic and Wiring Diagrams (fig. 60 and 61).*—These diagrams include all circuit components and show all electrical connections (power, input, and output) between all components.
- g. *Parts Identification Illustrations (fig. 39 through 57).*—These illustrations aid in identifying and locating parts.

**8003. Packing Procedure.**—When repacking TSEC/KL-7 for transportation, the following steps are to be followed:

- a. Check to see that all components of the cipher machine are securely fastened.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- b. Check to see that the operating light and power cable are properly fastened to their holding fixtures in the cover.
- c. Check to see that the receptacle of the power cable is connected to the storage plug assembly.
- d. Place the cipher machine in its carrying case and fasten the cover in place.
- e. If the cipher machine is to be shipped a considerable distance, one metal shipping band should be placed around the case so as to further secure the cover to the case.

**8004. Transporting TSEC/KL-7 on Packboard (fig. 7).**—TSEC/KL-7 is easily transported on the standard packboard in its carrying case. To lash the unit to the packboard, follow the instructions outlined below:

- a. Be certain that the canvas on the packboard is tight, and adjust the shoulder straps so as to keep the load high and comfortable.
- b. Lay the packboard on the ground with the shoulder straps down and remove the lashing rope from the board.

*Note:* The lashing rope is normally used to secure the TSEC/KL-7 carrying case to the packboard. However, if rope is not available, field wire or any other field expedient may be used.

- c. Slide TSEC/KL-7 completely into the case, place the cover in position, and fasten the six cover-holding latches.
- d. Lay the carrying case on its side on the upper portion of the packboard in such a position that it will be carried upright with the carrying case handle folded *away* from the packboard (see fig. 7).

*Note:* It is important that the case be positioned on the packboard as outlined above so as to provide even distribution of the load.

- e. Lash the carrying case to the packboard, weaving the rope back and forth and diagonally across the board. No detailed method of lashing is given here since there are numerous methods. Pull the lashing rope as tight as possible to prevent any shifting of the case. Use knots which are easy to untie.

**CAUTION: DO NOT DROP THE LOADED PACKBOARD TO THE GROUND.**

- f. Wind the lashing rope around the top of the board when not in use.

**8005. Vehicle Mounting Kit (fig. 6).**—The vehicle mounting kit provides for mounting the TSEC/KL-7 cipher machine in  $\frac{1}{4}$ -ton,  $\frac{3}{4}$ -ton, and  $2\frac{1}{2}$ -ton military vehicles. The following instructions pertain specifically to the  $\frac{1}{4}$ -ton, 4 x 4 vehicle (Jeep), but, with certain modifications, are adaptable to all vehicles.

*Note:* See Appendix C for replaceable parts.

- a. *Mounting Plates.*—Fasten the CE 87308 mounting plate to the bottom of the TSEC/KL-7 carrying case, using the four  $\frac{3}{4}$ -inch, #  $\frac{1}{4}$ -24 screws and four  $\frac{1}{4}$ -inch lock washers provided in the kit.
- b. *Mounting Assembly.*—Fasten the CE 87359 mounting assembly to the vehicle as follows:
  - (1) Select a position in the vehicle to mount the assembly. The right rear wheel well is usually the most adaptable because of convenient access to the battery outlet.
  - (2) Set the mounting assembly into position, taking into consideration such things as the position of the front seat, position of the operator, etc.
  - (3) Make certain the assembly is parallel to the edge of the wheel well, and with a pencil, make an outline on the fender well of the outside edge of both base plates.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- (4) Remove the upper portion of the assembly from the shock mounts by removing the four bolts and lock washers which hold this assembly.
  - (5) Set the base plates in place on the wheel well and mark two mounting holes farthest from the inside edge of each mounting plate. (The countersunk mounting holes on each base plate are not used in this installation.) Center-punch the holes and drill with a  $\frac{5}{16}$ -inch drill.
  - (6) Reassemble the mounting assembly and ascertain that all holes have been properly drilled.
  - (7) Remove the mounting assembly from the top of the wheel well and perform the following:
    - (a) A backboard of either  $\frac{3}{8}$ - or  $\frac{1}{2}$ -inch thick plyboard must be fitted between the top side of the wheel well and the mounting assembly base plates. Groove the plyboard so that it straddles the ridges of the wheel well.
    - (b) Set the plyboard into position, mark the four mounting holes from the underside of the wheel well, and drill the holes with a  $\frac{5}{16}$ -inch drill.
  - (8) From the underside of the wheel well, hold one of the CE 87418 mounting strips in place so that it is parallel to the axle of the vehicle. Mark the two holes drilled in step (5) above from the top of the wheel well, center-punch, and drill with  $\frac{5}{16}$ -inch drill. Repeat for the other mounting strip.
  - (9) Set the plywood backboard and mounting assembly into position and insert the four # $\frac{5}{16}$ -24 x  $1\frac{1}{4}$ -inch screws into the mounting holes.
  - (10) From the underside of the wheel well, hold each of the reinforcing strips in place and fasten the complete assembly with four # $\frac{5}{16}$ -24 nuts and  $\frac{5}{16}$ -inch lock washers.
- c. *Terminal Box Assembly.*—Mount the CE 87354 terminal box assembly in some convenient place in the vehicle near the TSEC/KL-7 mount. Use two # $\frac{5}{16}$ -24 x  $\frac{3}{4}$ -inch screws, two  $\frac{5}{16}$ -inch lock washers, and two # $\frac{5}{16}$ -24 nuts.
- d. *Electrical Elements.*
- (1) Solder the white lead of the CE 87358 rubber covered cable to terminal B of the CE 87355 cable accessory assembly. Solder the black lead of the cable to terminal A of the accessory assembly.
  - (2) Assemble the CE 87355 cable accessory assembly as follows:
    - (a) Insert the ring into the large barrel with the flat surface down.
    - (b) Drop the small barrel into the large barrel so that the small barrel grommet is against the ring bevel.
    - (c) Set the ring on the CE 87356 connector so that the ring fits against the ridge of the connector and tightens the unit.
  - (3) Measure the length of cable necessary to run from the vehicular battery outlet to the terminal box assembly. Cut and discard excess cable.
  - (4) Strip and tin the cable end which is to fit into the terminal box and fit the cable into the large stuffing tube on the box.
  - (5) The two outside terminals in the terminal box are ground. The two center terminals are hot. Fasten the black lead (positive) on the hot terminal to which the capacitor is connected. Fasten the white (negative) lead to the grounded top terminal.
  - (6) Fasten the CE 87355 cable to the vehicle chassis, using the clamps and mountings supplied in the CE 87363 cable clamp package.
  - (7) If the installation is to be one of a permanent nature, cut the CE 14643 cable provided in the TSEC/KL-7 carrying case to a convenient length. Unscrew the top plug of the terminal box assembly and fit the CE 87357 stuffing tube into position. Push the CE 14643 cable through the stuffing tube and fasten the black and white leads to their respective terminals as prescribed in subparagraph (5) above.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

8100—TROUBLE-SHOOTING CHARTS

8101. Trouble-Shooting Charts.—Trouble-shooting charts appear on the following pages as follows:

- a. Chart No. 1—Trouble Shooting TSEC/KL-7—pages 149 through 156.
- b. Chart No. 2—Trouble Shooting TSEC/KL-7 with the Oscilloscope— pages 157 through 159.
- c. Chart No. 3—Typical Voltage Readings—page 161.

~~CONFIDENTIAL~~



## CHART NO. 1--TROUBLE SHOOTING TSEC/KL-7

TABLE 1  
KEYBOARD AND SLIDING CONTACT BOARD ASSEMBLIES

Trouble	Probable Cause	Remedy
Motor does not run when selector handle is turned from O position, and filaments do not light. (See also Tables 2 and 3.)	Loose connection under power cable and cover plate assembly. Broken power cable conductor. Defective power switch or bent spring leaf.	Tighten loose connection.  Replace power cable. Replace switch or straighten spring leaf and check leaf tension.
Dead key switch in P, E, and D operation. (See also Table 3.)	Dirty key switch contact.  Open between P pressure contact and pulse generator.	Clean key switch contact.  Check continuity of key circuit.
Roving dead key switch in E or D operation, and permanent dead key switch in opposite, D or E, operation. P operation normal. (See also Table 4.)	Dirty or defective E or D pressure contact.  Open between E or D pressure contact and cipher unit.	Clean or replace defective pressure contact.  Check continuity of key circuit.
Roving dead key switch in E and D operation, but normal operation in P position.	Dirty shorting bar.	Clean sliding contact board assembly.
No printing unless RPT key switch depressed. Rotor stepping normal. In figures condition, only single character prints with depression of RPT key switch.	Open in keyboard common post.	Clean or replace keyboard common post.
Keyboard dead in P operation, but operates normally in E and D operations.	Open or dirty contact at K5.	Check continuity between K3, K5, and K4.
No automatic stepping when selector handle moved from P to E position.	Faulty contact between K20 and K21.	Clean sliding contact board assembly.

CONFIDENTIAL

CONFIDENTIAL

149

ORIGINAL

KAM-1/TSEC

CHART NO. 1—(Continued)  
**TABLE 2**  
**CONTACT PANEL ASSEMBLY**

Trouble	Probable Cause	Remedy
Motor does not run when selector handle turned from O position, but filaments light. (See also Tables 1 and 3.)	Open circuit in contact panel wiring.	Check continuity between M1 and M2 with keyboard and sliding contact panel assemblies in position.
Depression of any key switch results in repeat operation.	Inadequate bias at shield grid to tube V101.	Check for defective tube V101 or V104. Check for open or short in circuitry of tube V104.
Depression of any key switch results in repeat operation. Neon glow lamp cannot be extinguished, and depression of set key causes continuous printing.	Defective bias supply at point common to all tubes.	Check bias supply at points common to all tubes.
Depression of RPT key switch by itself results in continuous operation. Depression of any key switch results in misprinting.	Inadequate bias at control grid of tube V101.	Check for short between cathode and control grid of tube V101. Check for shorted resistor R105. Check for defective tubes V101 or V102. Check for open or short in circuitry of tubes V101 or V102.
Keyboard dead in P, E, and D operations. (See also Table 3.)		
a. Except when RPT key switch depressed.	Bias at shield grid of tube V101 not removed with depression of key switch.	Check for defective tube V104. Check for open in filament circuit for tube V104. Check for open or short in circuitry of tube V104. Check for open in repeat cam switch.
b. Except for FIG and LET key switches.	Defective tubes V101 or V102. Open or short in circuitry of tubes V101 or V102.	Replace defective tube. Check circuitry for tubes V101 and V102.
c. FIG and LET key switches dead also, but motor runs and filaments light.	Shorted resistor R119.	Replace resistor R119.
Motor runs but filaments do not light.	Open in filament circuit.	Check continuity of filament circuit.

KAM-1/7SEC

CONFIDENTIAL

150

ORIGINAL

CHART NO. 1—TABLE 2 (Continued)

Trouble	Probable Cause	Remedy
Neon glow lamp does not light when FIG key switch depressed. (See also Table 3.)	Defective neon glow lamp. Defective diode D103 and D105. Open between K35 and J2.	Replace defective neon glow lamp. Replace defective diodes. Check continuity between two points.
Neon glow lamp does not extinguish properly when LET key depressed. (See also Table 3.)		
a. Neon glow lamp lights when machine turned from O position, and depression of LET key switch does not extinguish it.	Inadequate bias supply for tube V103.	Check bias supply for tube V103.
b. After first shift from FIG to LET condition, depression of letters key switch does not extinguish neon glow lamp.	Open resistor R115.	Replace R115.
c. Neon glow lamp extinguishes only momentarily when LET key depressed.	Shorted resistor R118.	Replace resistor R118.
Keyboard action sluggish, some key switches seem dead, and depression of key switch causes motor to drag.	Shorted resistor R114.	Replace resistor R114.

CONFIDENTIAL

CONFIDENTIAL

151

ORIGINAL

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

CHART NO. 1—(Continued)  
**TABLE 3**  
**PRINTER UNIT ASSEMBLY**

Trouble	Probable Cause	Remedy
<p>Paper tape does not space properly.</p> <p>a. Erratic or no double spacing in E operation.</p> <p>b. Five-letter groupings occur in P or D operation.</p> <p>c. Erratic spacing in P operation.</p>	<p>Defective double-drive ratchet pawl spring.                      Defective detent ratchet pawl spring.                      Defective double-drive ratchet compression spring.                      Effective length of double-drive ratchet pawl too long or too short.</p> <p>Defective stop pawl spring.</p> <p>Maladjusted no-back pawl.                      Defective single-drive ratchet pawl spring.</p>	<p>Replace defective spring.                      Replace defective spring.                      Replace defective spring.                      Adjust effective length of double-drive ratchet pawl.</p> <p>Replace defective spring.</p> <p>Adjust no-back pawl.                      Replace defective spring.</p>
<p>Ribbon reversing mechanism does not function properly.</p> <p>a. More than two printing operations necessary for ribbon to reverse.</p> <p>b. Ribbon does not space properly.</p>	<p>Improper right or left ribbon spool spring tension.</p> <p>Improper shifting lever spring tension.</p>	<p>Replace defective spring.</p> <p>Replace defective spring.</p>
<p>Machine does not print properly.</p> <p>a. Printing either too heavy or too light.</p> <p>b. Wrong character prints, but rotors step properly. Machine cannot decipher its own message.</p> <p>c. Rotors step in prescribed pattern but no printing occurs.</p>	<p>Maladjusted print hammer.</p> <p>Maladjusted figured wheel.</p> <p>Short in print magnet.                      Mechanically defective print magnet.</p>	<p>Adjust print magnet eccentric.</p> <p>Adjust figured wheel.</p> <p>Check continuity in print magnet circuit.                      Replace defective print magnet assembly.</p>

152

ORIGINAL

KAM-17SEC

CHART NO. 1—TABLE 3 (Continued)

Trouble	Probable Cause	Remedy
<p>Dead keys revealed in printing operations. (See also Table 1.)</p> <p>a. Dead key switch in P operation, and roving dead key switch in E and D operation.</p> <p>b. Same character prints when either of two keys depressed.</p>	<p>Dirty contact at pulse generator.</p> <p>Short across two contacts at pulse generator. Short across two character coils in pulse generator.</p>	<p>Clean dirty contact.</p> <p>Repair shorted contacts. Replace pulse generator assembly.</p>
<p>Timing unit cam switches do not operate correctly.</p> <p>a. Single letter prints followed by slight buzzing noise and failure of neon lamp to ignite when FIG key switch depressed. No further printing possible unless selector handle switched from P to O position and back to P.</p> <p>b. No printing except when RPT key switch depressed.</p> <p>c. Machine shifts to figures condition in E or D operation, but automatically returns to letters condition on next key switch operation. (See also Table 2.)</p> <p>d. Machine shifts to letters condition in E or D operation, but automatically returns to figures condition on next key switch operation (See also Table 2.)</p> <p>e. Sluggish but normal keyboard operation. (See also trouble listed under Motor-Generator (Table 8).</p>	<p>Maladjusted charge cam switch.</p> <p>Maladjusted repeat cam switch.</p> <p>Maladjusted letters cam switch.</p> <p>Maladjusted figures cam switch.</p> <p>Maladjusted charge cam switch.</p>	<p>Adjust charge cam switch.</p> <p>Adjust repeat cam switch.</p> <p>Adjust letters cam switch.</p> <p>Adjust figures cam switch.</p> <p>Adjust charge cam switch.</p>

CONFIDENTIAL

CONFIDENTIAL

CHART NO. 1—TABLE 3 (Continued)

Trouble	Probable Cause	Remedy
<p>Timing shaft does not cycle properly.</p> <p>a. Machine prints but does not cycle.</p> <p>b. Occasional double cycle during printing or when selector handle turned from P to E position.</p> <p>c. Continuous loud chatter on attempting to cycle timing shaft.</p> <p>d. Continuous buzz between cycles.</p> <p>e. Continuous cycling of timing shaft.</p>	<p>Defective clutch pawl spring. Shorted or leaky capacitor C109.</p> <p>Maladjusted clutch trip magnet position. Clutch trip magnet armature sticking to magnet core.</p> <p>Defective clutch detent pawl spring.</p> <p>Defective clutch detent pawl spring.</p> <p>Broken clutch trip magnet armature retaining spring.</p>	<p>Replace defective spring. Replace capacitor C109.</p> <p>Adjust clutch trip magnet position. Clean magnet core and armature.</p> <p>Replace defective spring.</p> <p>Replace defective spring.</p> <p>Replace clutch trip magnet assembly.</p>
<p>Motor-Generator and controller does not function properly.</p> <p>a. Keyboard reaction sluggish and figured wheel prints on leading edge of character. (See also trouble listed under Timing unit cam switches. . . (Table 3).)</p> <p>b. Motor does not run when selector handle turned from O position, but tube filaments light. (See also Tables 1 and 2.)</p> <p>c. Keyboard dead and no automatic stepping of rotors between P and E position, but motor runs and rotors step properly. (See also Table 2.)</p> <p>d. Motor overspeeds.</p>	<p>Inadequate motor speed.</p> <p>Pressure contacts N1 and N2 do not meet mating contacts on contact panel assembly. Defective motor brush.</p> <p>Pressure contacts N3 and N4 do not meet mating contacts.</p> <p>Loose connection at negative coefficient resistor.</p> <p>Loose connection at adjustable resistor.</p>	<p>Check motor speed adjustment.</p> <p>Check motor-generator and controller alignment. Check internal continuity of motor circuit.</p> <p>Check motor-generator and controller contact alignment. Check continuity between N3 and N4.</p> <p>Tighten loose connection.</p> <p>Tighten loose connection.</p>

CONFIDENTIAL

KAM-1/TSEC

CONFIDENTIAL

154

ORIGINAL

CONFIDENTIAL

CONFIDENTIAL

CHART NO. 1 (Continued)

TABLE 4  
 ROTOR STEPPING AND CIPHER UNIT ASSEMBLIES

Trouble	Probable Cause	Remedy
Cipher unit does not maintain stepping pattern.	Maladjusted actuator switches.	Adjust actuator switch contact clearances. Clean actuator switch contacts.
Depression of set key in P operation does not step rotor.	Sluggish action in stepping magnets.  Improper engagement between carrier drive linkage and rotor.    Maladjustments in rotor stepping magnet positions.	Clean armature and core of dirty magnets.  Apply drop of oil to eccentric pin of defective carrier linkage.  Check hold-down and drive pawl spring tensions, and replace defective springs.  Check rotor stepping drive pawl effective length adjustment.  Check rotor stepping magnet position adjustment.
Cipher unit does not maintain stepping pattern, but individual rotors step correctly when set keys are depressed in P operation.	Open at terminal #5 on one of the actuator switches.	Repair open circuit.
Stepping magnets do not energize but timing shaft cycles.	Open in common connection.	Check continuity of common circuit of rotor stepping unit.
No stepping magnets energize in P operation, but timing shaft cycles.	Open 24-volt connection in P operation.	Check continuity of 24-volt circuit for P operation.
No stepping magnets energize in E or D operation, but timing shaft cycles.	Open 24-volt connection in E and D operation.	Check continuity of 24-volt circuit for E and D operation.
Stepping magnets energize in P position, but rotors do not step. Otherwise operation normal, i. e., depression of key switch results in normal printing.	Open return circuit to clutch trip magnet.	Check continuity of clutch trip magnet return circuit.

CHART NO. 1—TABLE 4 (Continued)

Trouble	Probable Cause	Remedy
In P operation, more than single rotor steps when set key depressed, and depression of key switch causes rotor stepping.	24 volts for E and D operation shorted to 24 volts for P operation.	Locate short in rotor stepping unit.
Timing shaft cycles continuously in P operation owing to continuous energization of clutch trip magnet.	Short between # 1 and # 4 on actuator switch.	Locate short in rotor stepping unit.
Counter unit does not function correctly.	Maladjusted counter arm.	Adjust counter arm.
<p>Dead keys in E and D operation.</p> <p>a. Roving dead key switch in E and D operation.</p> <p>b. Roving dead key switch in E or D operation, and permanent dead key in opposite (D or E) operation. (See also Table 1.)</p>	<p>Open in reentry circuit.</p> <p>Open in one of the rotors.</p> <p>Open in one of the 26 entry circuits in cipher unit on either E or D side.</p>	<p>Check continuity of reentry circuits in rotor stepping unit.</p> <p>Check rotor continuity through cipher unit.</p> <p>Locate and repair open.</p>

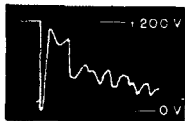


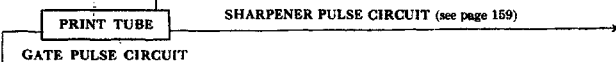
Folded Page 157  
 Contains  
 Chart No. 2-1—Trouble Shooting TSEC/KL-7  
 with an Oscilloscope

**CHART NO. 2—TROUBLE SHOOTING TSEC/KL-7 WITH THE OSCILLOSCOPE**

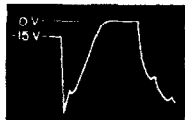
*Note:* It is suggested that the information outlined below be used as an aid in isolating troubles in the electronic circuits of TSEC/KL-7. The chart is based on the assumption that the motor runs when the selector handle is operated, but there is no printing. The circuit tracing should be conducted in the order given, starting with tube V101, and proceeding back through the gate and character pulse circuits until the defective component is determined. The representative waveforms illustrated were modeled from actual scope presentations using a sweep triggered by key closure. Allowable tolerances in oscilloscopes and TSEC/KL-7 machines may result in waveshapes which vary slightly from those illustrated.

Test Point—Plate of tube V101 (F1 and F2)

Print Drive Pulse	Print Drive Pulse	
	Distorted Pulse	No Pulse
	<ol style="list-style-type: none"> <li>1. Defective print magnet</li> <li>2. Dirty or defective charge cam switch</li> <li>3. Open capacitor C101, C102, C106, or C107</li> <li>4. Defective resistor R127</li> </ol>	<ol style="list-style-type: none"> <li>1. Defective tube V101</li> <li>2. Open print magnet</li> <li>3. Open charge cam switch</li> <li>4. Shorted capacitor C101, C102, C106, or C107</li> <li>5. Shorted resistor R127</li> </ol>




Test Point—Shield Grid of Tube V101 (X1)


Gate Pulse	Gate Pulse	
	Distorted Pulse	No Pulse
	<ol style="list-style-type: none"> <li>1. Distorted transient gate pulse</li> <li>2. Defective tube V104</li> <li>3. Open charge cam switch</li> <li>4. Defective print magnet</li> </ol>	<ol style="list-style-type: none"> <li>1. Shorted RPT key</li> <li>2. No transient gate pulse</li> <li>3. Open repeat cam switch</li> </ol>

**GATE TUBE STAGE**

Test Point—Plate #1 of tube V104 (V3)

Multivibrator Pulse	Multivibrator Pulse	
	Distorted Pulse	No Pulse
	<ol style="list-style-type: none"> <li>1. Shorted or open capacitor C105</li> <li>2. Shorted or open resistor R114, R126, or R131</li> <li>3. Defective tube V104</li> </ol>	<ol style="list-style-type: none"> <li>1. Absence of transient pulse</li> <li>2. Open capacitor C105</li> <li>3. Open resistor R114 or R131</li> </ol>

Test Point—Cathode of tube V104 (X10)

Transient Gate Pulse	Transient Gate Pulse	
	Distorted Pulse	No Pulse
	<ol style="list-style-type: none"> <li>1. Defective diode D101, D102, or D115</li> <li>2. Shorted transformer (T101)</li> <li>3. Shorted pulse coil</li> </ol>	<ol style="list-style-type: none"> <li>1. Shorted or open pulse coil</li> <li>2. Defective or dirty key contacts</li> </ol>

Test Point—Cathode of diode D115 (V14)


Transient Pulse	Transient Pulse	
	Distorted Pulse	No Pulse
	<ol style="list-style-type: none"> <li>1. Shorted or open capacitor C116</li> <li>2. Shorted RPT key</li> <li>3. Defective tube V104</li> <li>4. Shorted or open capacitor C117</li> <li>5. Open resistor R118</li> </ol>	<ol style="list-style-type: none"> <li>1. Defective tube V104</li> <li>2. Shorted RPT key</li> <li>3. Shorted capacitor C116</li> <li>4. Open repeat cam switch</li> </ol>

Chart No. 2-2—Trouble Shooting TSEC/KL-7  
with an Oscilloscope

Folded Page 159

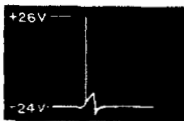
Contains

CONFIDENTIAL

CONFIDENTIAL

SHARPENER PULSE CIRCUIT—(Continued from page 157)

Test Point—Grid of tube V101 (V1)



Sharpener Pulse

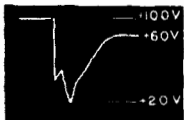
Distorted Pulse

No Pulse

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Defective tube V101</li> <li>2. Shorted or leaky capacitor C114</li> <li>3. Defective print magnet</li> <li>4. Defective charge cam switch</li> </ol> | <ol style="list-style-type: none"> <li>1. Open capacitor C114</li> <li>2. No output from sharpener tube</li> </ol> |
|---|--|

SHARPENER TUBE STAGE

Test Point—Plate of tube V102 (X2)



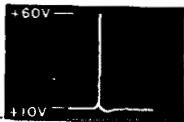
Sharpener Tube Recovery Pulse

Distorted Pulse

No Pulse

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Distorted input to tube V102</li> <li>2. Defective tube V102</li> <li>3. Defective capacitor C118 or C114</li> <li>4. Defective resistor R111</li> <li>5. Incorrect bias on tube V102</li> </ol> | <ol style="list-style-type: none"> <li>1. No input to tube V102</li> <li>2. Defective tube V102</li> <li>3. Open or shorted capacitor C118</li> </ol> |
|--|---|

Test Point—Cathode of tube V102 (SW3)(x.5)



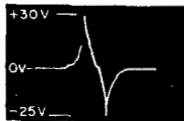
Sharpener Tube Output

Distorted Pulse

No Pulse

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Distorted input to tube V102</li> <li>2. Shorted capacitor C114</li> <li>3. Defective tube V102</li> <li>4. Incorrect bias on tube V102</li> <li>5. Defective resistor R111 or R120</li> </ol> | <ol style="list-style-type: none"> <li>1. No input to tube V102</li> <li>2. Defective tube V102</li> <li>3. Open resistor R111 or R120</li> <li>4. Incorrect bias on tube V102</li> </ol> |
|--|---|

Test Point—Control grid of tube V102 (Pin #1)



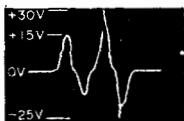
Character Pulse Input To Tube V102

Distorted Pulse

No Pulse

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Distorted alphabet character pulse</li> <li>2. Defective pulse transformer</li> <li>3. Defective pulse generator coil</li> <li>4. Incorrect bias on tube V102</li> <li>5. Shorted capacitor C118 or C114</li> <li>6. Defective diodes D101, D102, or D115</li> </ol> | <ol style="list-style-type: none"> <li>1. No alphabet character pulse</li> <li>2. Open or shorted pulse transformer</li> </ol> |
|--|--|

Test Point—Control grid of tube V102 (Pin #1)



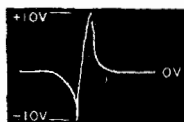
Alpha-Numeric Character Pulse Input to Tube V102

Distorted Pulse

No Pulse

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Distorted alpha-numeric pulse</li> <li>2. Defective secondary of pulse transformer (T101)</li> <li>3. Incorrect bias on tube V102</li> <li>4. Shorted capacitor C118 or C114</li> </ol> | <ol style="list-style-type: none"> <li>1. No alpha-numeric character pulse</li> <li>2. Open or shorted pulse transformer</li> </ol> |
|---|---|

Test Point—Cathode of diode D115 (V14)



Character Pulse Output of Pulse Transformer

Distorted Pulse

No Pulse

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Bad diode D101, D102, or D115</li> <li>2. Shorted pulse coil</li> <li>3. Shorted transformer (T101)</li> </ol> | <ol style="list-style-type: none"> <li>1. Shorted or open pulse coil</li> <li>2. Defective or dirty key contacts</li> </ol> |
|--|---|

159

ORIGINAL  
Reverse (Page 158) Blank

KAM-1793C

~~CONFIDENTIAL~~

KAM-1/TSEC

**CHART NO. 3—TYPICAL VOLTAGE READINGS**  
(with 20,000 ohms VOM at 24-volt input)

The following voltage readings were all measured from terminal points which are pointed out on the schematic wiring diagram in this publication. Use of these readings along with the schematic and the wiring diagram provide a convenient means of trouble shooting the TSEC/KL-7.

The readings given on the following chart are measured from the designated terminal point to terminal C9 on the common bus, unless otherwise specified.

From	Terminal Reading (1)	From	Terminal Reading (1)
A1	0	W1	-65 to - 75
A2	0	W2	+215
A3	+ 24 (4)	W2	+190 (2)
A4	+ 24 (5)	W3	+215
C1	+ 24	W7	0
C2	+ 19	W8	+220
C10	+ 6.5	X1	- 19 (6)
C11	- 30	X1	0 (7)
U4	+240	X3	+180 (8)
U4	+180 to +190 (2)	X3	+220 (9)
V1	- 27	X4	+180 (8)
V5	+240	X4	+230 (9)
V5	+205 (2)	X9	+ 40
V6	+ 1	Y5	- 8.5
V6	+ 17 (3)	V101-1	- 27
V14	+200	M3-M4 (10)	150-165 AC

- Note:*
- (1) All readings taken with machine in letters operation, unless otherwise specified.
  - (2) Figures operation.
  - (3) Figures operation, plain or decipher operation.
  - (4) Encipher or decipher operation.
  - (5) Plain operation.
  - (6) RPT key released.
  - (7) RPT key depressed.
  - (8) Figures condition.
  - (9) Letters condition.
  - (10) Measure between M3 and M4 using AC scale.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

**8200—SUPPLEMENTARY INSTRUCTIONS FOR TRAINED  
MAINTENANCE PERSONNEL**

**8201. CE 87383 Stator and End Bell Assembly.**

- a. The CE 87383 Stator and End Bell Assembly is a special component grouping of parts designed to meet the critical tolerances necessary in the pulse generator. It comprises the following parts:

- |                                     |                            |
|-------------------------------------|----------------------------|
| (1) CE 87053 Rotor                  | (6) CE 87064 End Bell      |
| (2) CE 11276 Loading Spring         | (7) CE 87050 End Bell      |
| (3) CE 87055 Stator and Contact     | (8) CE 54599 Spacer        |
| (4) CE 11286 Stator                 | (9) CE 11834 Screw         |
| (5) CE 87060 End Bell and Tape Feed | (10) CE 14595 Ball Bearing |

- b. Disassemble the CE 87383 Stator and End Bell Assembly as follows:

*Note:* Procedures outlined below assume that the pulse generator has been disassembled as described in paragraph 7307. Further, the gear housing should be removed by means of the four CE 11842 screws and the CE 11830 lock washers.

- (1) Remove the four CE 11834 screws that secure the stator between the two end bells.
- (2) Using a soft headed hammer, tap off the CE 87064 front end bell, taking care not to damage the tape and ribbon feed drive shaft. Pick off the four CE 54599 spacers.
- (3) Pull out the CE 87053 rotor.
- (4) Using a soft headed hammer, tap off the CE 87050 rear end bell.
- (5) Reassemble the stator and end bell assembly, pulse generator, and printer unit. Mount the assembled component on a TSEC/KL-7 and perform the test procedures outlined in paragraph 3004.

**8202. Detailed Procedures for Disassembly of Motor-Generator and Controller Assembly.**

*Note:* The following procedures detail the necessary method for removing and replacing the motor-generator armature. Although pertaining specifically to the CE 88000 motor-generator, these instructions may also be used as a guide for replacing the armature in the CE 87420 motor-generator and controller assembly.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## a. Disassemble the motor-generator using the procedures outlined below:

- (1) Remove the printer from the equipment. Then remove the right and left hand dust shields that cover the timing unit.
- (2) Remove the four CE 11842 screws and four CE 11830 lock washers that secure the motor-generator to the rest of the printer and separate the printer into two sections.
- (3) Remove the end cover and the controller by unscrewing the two CE 11821 nuts, the two CE 11825 lock washers, and the two CE 14542 washers.
- (4) Remove the CE 88022 pinion gear by unscrewing the CE 11821 nut and the CE 11825 lock washer. Remove the CE 88085 key from the armature shaft.
- (5) Loosen the two setscrews and pull the CE 88031 governor from the armature shaft. Remove the two CE 88029 governor brush assemblies from the end cap assembly. Remove the two CE 88008 brush retaining caps and the motor brushes.
- (6) Remove the two CE 88035 standoffs from the motor-thru-bolts and pull the CE 88006 end cap assembly from the armature shaft. Make certain of the number of the CE 88034 shims when removing the cap so that the bearing will be correctly shimmed when the motor is reassembled.
- (7) Pull out the armature from the rear of the motor housing.
- (8) Remove the two CE 88084 bearings and the CE 88028 oil slinger from the armature.

*Note:* The front bearing may not pull out with the shaft. If so, remove the bearing from the motor housing.

## b. Prepare the new motor-generator armature for insertion into the unit as follows:

*Note:* Replacing the armature requires special test fixtures. Ordinarily this type of maintenance is reserved for major repair depots.

- (1) Mount the oil slinger that was previously removed from the discarded armature into position with the boss toward the rear of the shaft. Mount the two CE 88084 bearings on the shaft. The bearing should present a light press fit to the shaft and a slip fit to the bearing housing. Select new bearings if the old bearings cannot meet these requirements. Press bearings securely into position on the armature shaft.
- ~~(2) Magnetize the rotor end of the armature with a condenser-bank type magnetizing fixture (reference AT 70753). Use this magnetizer in conjunction with an eight pole holding fixture utilizing relative air gaps (reference AT 70754 and a dynamometer test-fixture, reference AT 70755).~~

~~*Note:* Procurement of the above referenced test fixtures may be initiated through normal Service channels.~~

- ~~(3) Magnetize magnet section of armature in fixture to obtain minimum flux density of 5000 gauss per pole measured at the minimum cross section of each pole. Drive armature assembly in generator field fixture at 6600 rpm and measure AC voltage. This voltage must not fall below 210 volts after shorting of the generator until the voltage stops decreasing. Test rotor in the generator field fixture in accordance with test specification CE 88083.~~

## c. Reassemble the motor-generator and controller assembly as follows:

- (1) Insert the armature into the motor housing with the rotor end foremost. Replace the CE 88006 end cap assembly, making certain that the CE 88084 bearing is correctly shimmed. When replacing the cap assembly, align the notch in the cap with the pin in the motor housing and press the cap into position.
- (2) Tuck wires from the brush holders under the field coil insulators. Make sure that the wires are positioned so that they will clear any moving parts. Replace the two CE 88035

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

standoffs on the motor-thru-bolts. Replace the CE 88030-1 positive brush assembly and the CE 88008 retaining cap in the top side of the end cap. Replace the CE 88030-2 negative brush assembly in the bottom side of the end cap.

- (3) Check the contact of the brush against the periphery of the commutator. At least 75 percent of the brush surface must engage the commutator. To achieve this, a run-in period may be necessary after which the commutator surfaces should be checked and cleaned. Check also to see that there is no bind between the brushes and the brush holders.
- (4) Replace the two CE 88029 governor brush assemblies. Replace the governor onto the armature shaft. Make certain there is about 0.030-inch clearance between the brush holders and the governor before tightening the setscrews.
- (5) Replace the CE 88085 key, the CE 88022 gear, the CE 11825 lock washer, and the CE 11821 nut on the armature shaft.
- (6) Remount the end cover using the two CE 14542 washers, two CE 11825 lock washers, and the two CE 11821 nuts previously removed.
- (7) Reassemble the motor-generator with the rest of the printer, using the CE 11842 screws and the CE 11830 lock washers previously removed.
- (8) Remount the printer onto the TSEC/KL-7 and check the motor speed adjustments as outlined in paragraph 6337 (or par. 6334 if using the old style motor-generator).

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## CHAPTER 9 REPLACEMENT PARTS

### 9000--GENERAL

#### 9001. Identifying Parts.

- a. Delays resulting from shipment of an incorrect part, or the inability to identify the part requested, can be eliminated by careful use of the replacement parts section of this document. Drawings representing most of the procurable parts and assemblies, with the part number and name shown, and a numerical list of parts and assemblies have been included in this publication. After the desired part has been identified on the drawing, and the part number ascertained, the number should be looked up in the numerical list to determine whether any specified ordering instructions have been noted therein.
- b. The numerical list of parts indicates the part number, nomenclature, total quantity used, the assembly number the part is used on, and the number of the figure where the part is illustrated. If the notation "Sev" appears in the "Used On" and/or "Fig. No." columns, it indicates the part is used on more than two figures. The letters "N. I." in the "Fig. No." column indicate that the part is not illustrated.

**9002. Ordering Parts.**—Parts shall be ordered in accordance with instructions issued by the Department or Agency having custody of the equipment.

*Note:* Navy holders shall order parts in accordance with instructions issued by the Bureau of Ships.

**9003. Disposal of Worn and/or Defective Parts.**—Worn and/or defective parts shall be disposed of in accordance with instructions issued by the Department or Agency having custody of the equipment.

*Note:* Navy holders shall dispose of worn and/or defective parts in accordance with instructions by the Bureau of Ships.

**9004. Emergency Repair.**—In emergencies, the cryptographic repair facilities of any of the Services may be utilized by any other Service.

**9005. List of Abbreviations.**—The following abbreviations are used in the List of Common Parts by Types, the Numerical List of Parts, and on illustrations.

Abbreviations	Definitions
amp	ampere
approx	approximately
Bind. H	binding head
cad.	cadmium
CHHSSS	case-hardened highspeed screw steel
CHSS	case-hardened screw steel
CRS	cold-rolled steel
csk	countersunk
CS	carbon steel
ctr	center

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Abbreviations	Definitions
cyl	cylindrical
dia	diameter
FH	flat head
Fil H	fillister head
ft	foot/feet
h	high
Hex H	hexagon/hexagonal head
HSCHS	highspeed case-hardened steel
ID	inside diameter
in.	inch
lg	long
loa	length over all
mtg	mounting
oa	over all
OD	outside diameter
oz	ounce
pl	plated
RH	round head
shldr	shoulder
sq	square
SS	screw steel
SST	stainless steel
stl	steel
term	terminal(s)
thd	thread
thk	thick
uf	microfarad
w	watt
w	wide
w/	with
ww	wire wound
v	volts

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

9006. Stamping Register Number On KLK-7/TSEC Nameplate.—When replacing a CE-87063 shell that has a register number stamped on the KLK-7/TSEC nameplate with one that does not have a register number, the AT16603 riveting fixture must be used. Mount the new shell on the fixture and stamp the number of the old shell on the nameplate of the new shell. Destroy the nameplate on the old shell.

*Note:* Stamping the nameplate without mounting the CE 87063 shell on the AT16603 riveting fixture may damage the surface of the shell sufficiently to cause rotors to bind.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Folded Pages 167 and 168  
Contain  
Figure 1

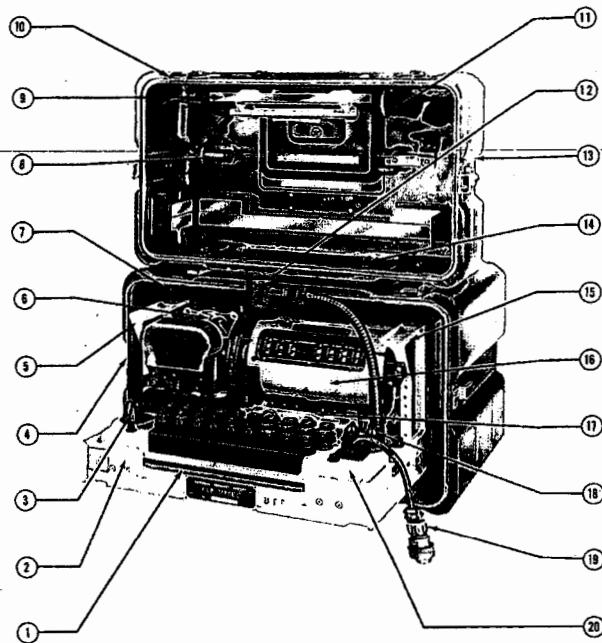


Fig. 1

- |                                 |                         |
|---------------------------------|-------------------------|
| 1. Contact Board                | 11. Cable               |
| 2. Base                         | 12. Operating Light     |
| 3. Selector Handle              | 13. Carrying Case Cover |
| 4. Carrying Case                | 14. Fastener Mounting   |
| 5. Left-hand Bracket            | 15. Right-hand Bracket  |
| 6. Printer                      | 16. Cipher Unit         |
| 7. Shock Mount                  | 17. Rotor Stepping Unit |
| 8. Operating Light Holder       | 18. Fuse Holder         |
| 9. Spare Ribbon and Copy Holder | 19. Power Cable         |
| 10. Latch                       | 20. Keyboard            |

~~CONFIDENTIAL~~

167

Change No. 3

~~CONFIDENTIAL~~

KAM-1/TSEC

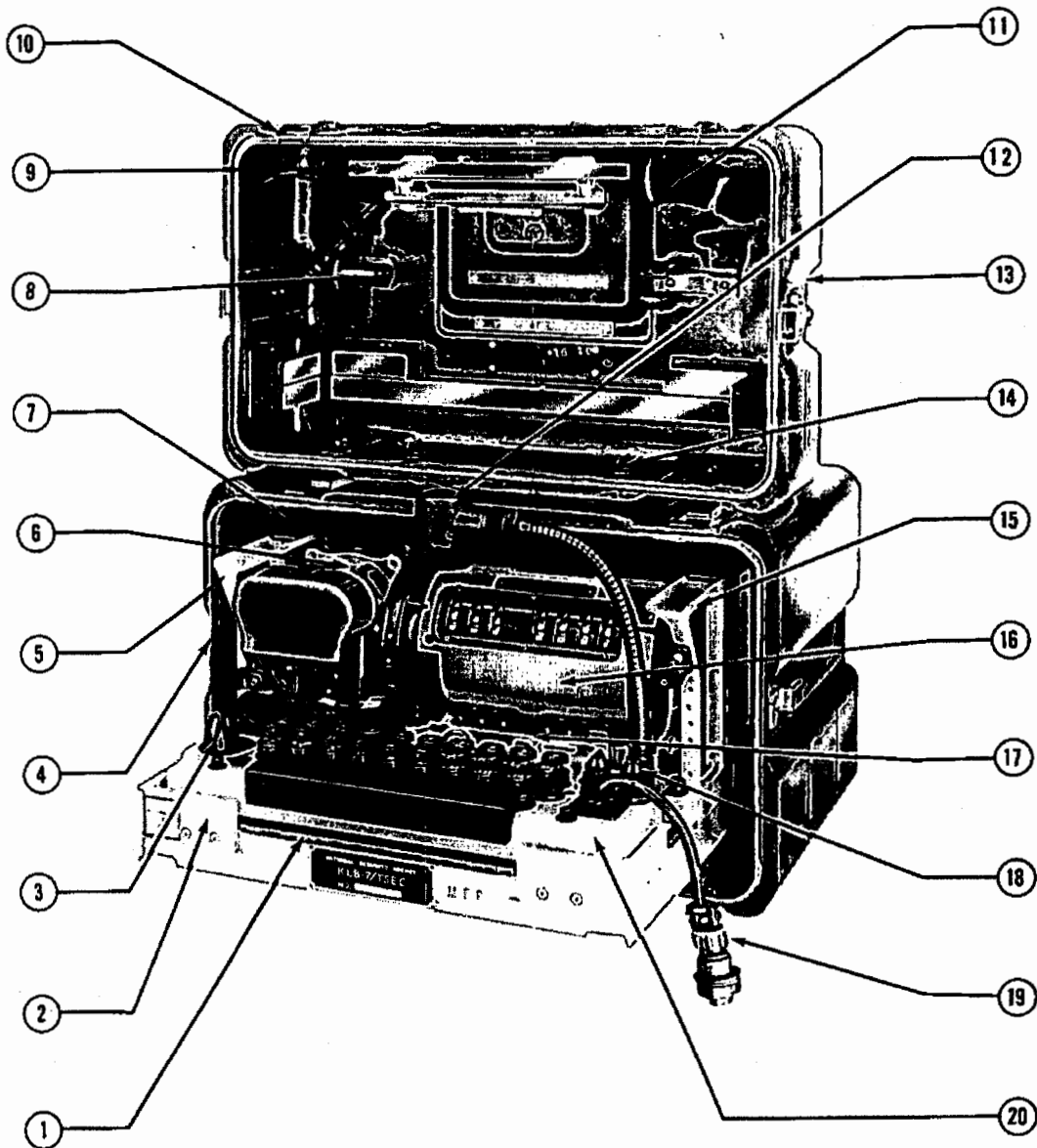


Fig. 1

- 1. Contact Board
- 2. Base
- 3. Selector Handle
- 4. Carrying Case
- 5. Left-hand Bracket
- 6. Printer
- 7. Shock Mount
- 8. Operating Light Holder
- 9. Spare Ribbon and Copy Holder
- 10. Latch

- 11. Cable
- 12. Operating Light
- 13. Carrying Case Cover
- 14. Fastener Mounting
- 15. Right-hand Bracket
- 16. Cipher Unit
- 17. Rotor Stepping Unit
- 18. Fuse Holder
- 19. Power Cable
- 20. Keyboard

~~CONFIDENTIAL~~

Folded Pages 169 and 170  
Contain  
Figure 2

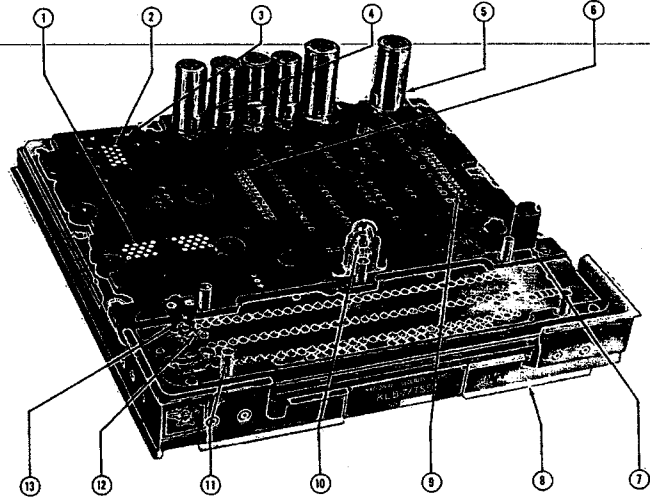


Fig. 2

- |  |                                    |
|--|------------------------------------|
| 1. Pulse Generator Contacts            | 8. Base                            |
| 2. Timing Unit Contacts                | 9. Cipher Unit Contacts (decipher) |
| 3. Motor Generator Controller Contacts | 10. Neon Glow Lamp                 |
| 4. Spare JAN 2D21 Tube Shield          | 11. Stand-off                      |
| 5. Spare JAN 12AX7 Tube Shield         | 12. Keyboard Contacts              |
| 6. Cipher Unit Contacts (encipher)     | 13. Follower                       |
| 7. Operating Light Socket              |                                    |

~~CONFIDENTIAL~~

KAM-1/TSEC

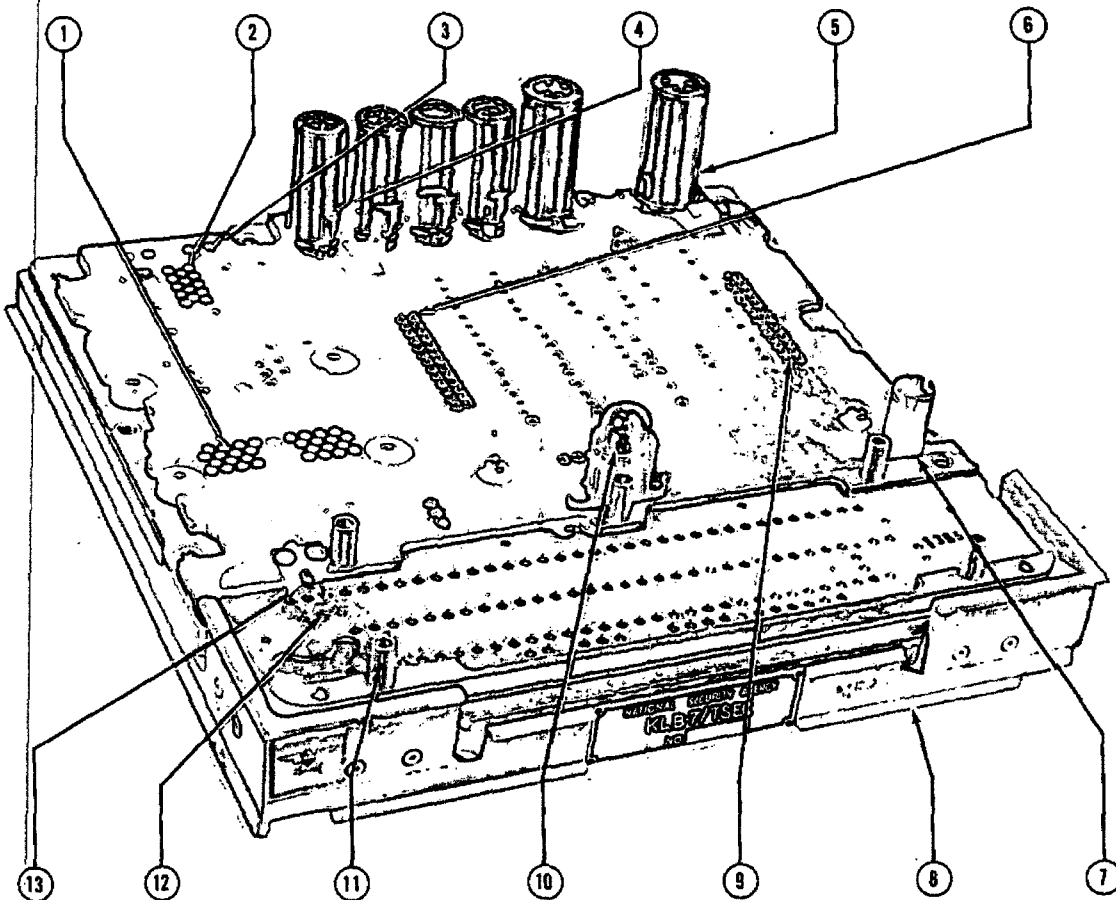


Fig. 2

- |  |                                    |
|--|------------------------------------|
| 1. Pulse Generator Contacts            | 8. Base                            |
| 2. Timing Unit Contacts                | 9. Cipher Unit Contacts (decipher) |
| 3. Motor Generator Controller Contacts | 10. Neon Glow Lamp                 |
| 4. Spare JAN 2D21 Tube Shield          | 11. Stand-off                      |
| 5. Spare JAN 12AX7 Tube Shield         | 12. Keyboard Contacts              |
| 6. Cipher Unit Contacts (encipher)     | 13. Follower                       |
| 7. Operating Light Socket              |                                    |

~~CONFIDENTIAL~~

Folded Pages 171 and 172  
 Contain  
 Figure 3

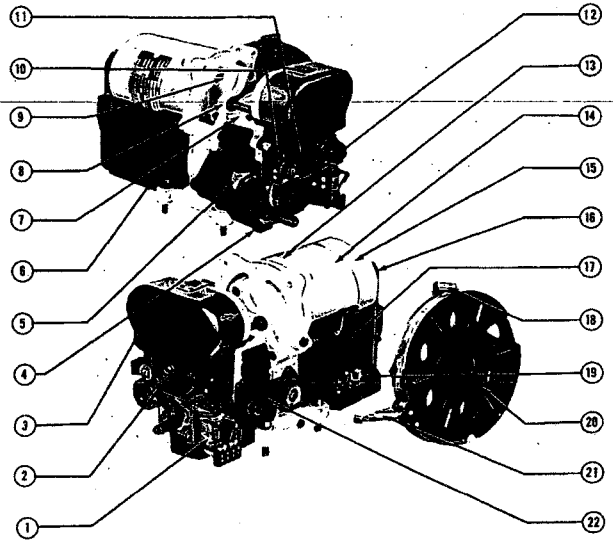


Fig. 3

- |                          |   |
|--------------------------|---|
| 1. Print Magnet          | 13. Generator (section)                     |
| 2. Figured Wheel         | 14. Motor (section)                         |
| 3. Ribbon Cover          | 15. Motor Generator and Controller Assembly |
| 4. Dust Cover            | 16. Controller (section)                    |
| 5. Dust Cover            | 17. Dust Cover                              |
| 6. Dust Cover            | 18. Swivel Pin                              |
| 7. Pulse Generator       | 19. Drive Link                              |
| 8. Rear-end Bell         | 20. Paper Tape Container                    |
| 9. Gear Housing          | 21. Guide Block                             |
| 10. Feed-roller follower | 22. Dust Cover                              |
| 11. Paper-tape Guide     |   |
| 12. Paper-tape Feed Roll |   |

~~CONFIDENTIAL~~

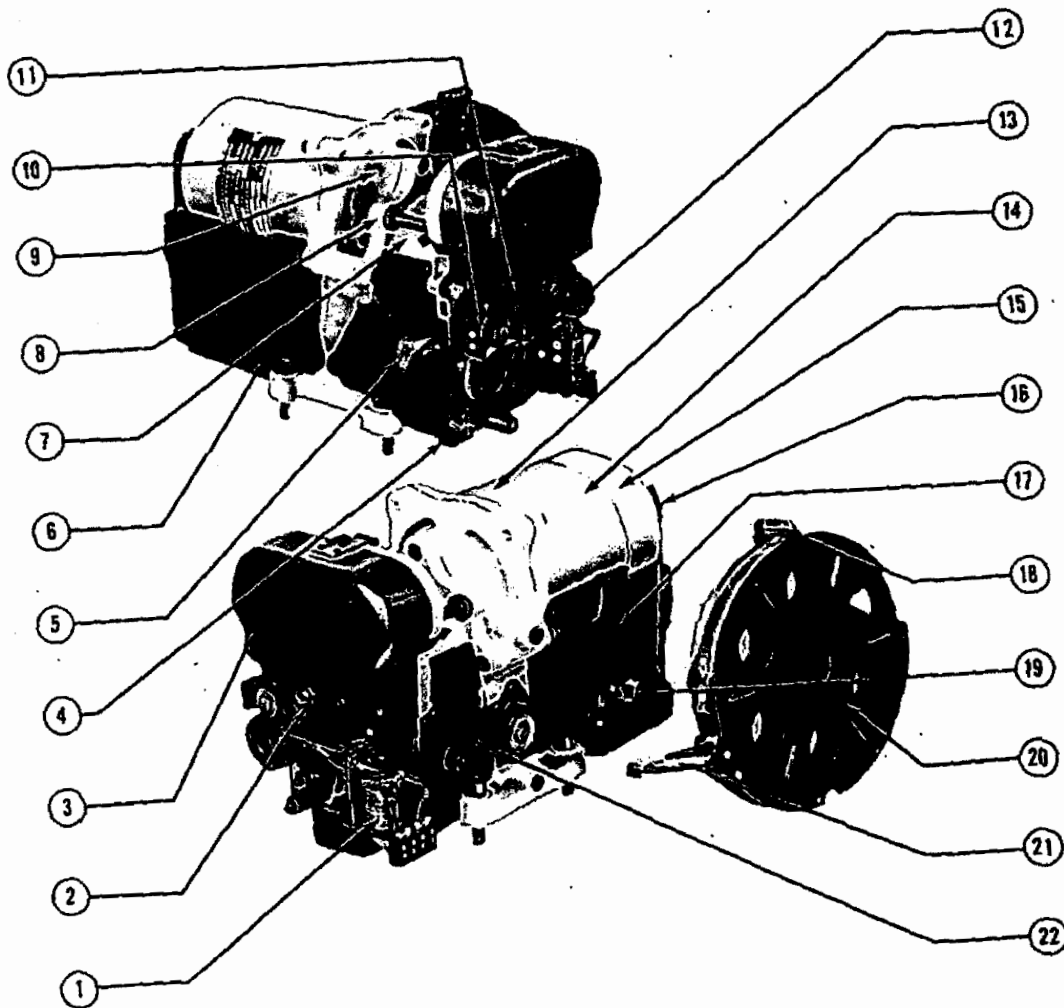


Fig. 3

- 1. Print Magnet
- 2. Figured Wheel
- 3. Ribbon Cover
- 4. Dust Cover
- 5. Dust Cover
- 6. Dust Cover
- 7. Pulse Generator
- 8. Rear-end Bell
- 9. Gear Housing
- 10. Feed-roller follower
- 11. Paper-tape Guide
- 12. Paper-tape Feed Roll

- 13. Generator (section)
- 14. Motor (section)
- 15. Motor Generator and Controller Assembly
- 16. Controller (section)
- 17. Dust Cover
- 18. Swivel Pin
- 19. Drive Link
- 20. Paper Tape Container
- 21. Guide Block
- 22. Dust Cover

~~CONFIDENTIAL~~

Folded Page 173 and 174  
Contain  
Figure 4

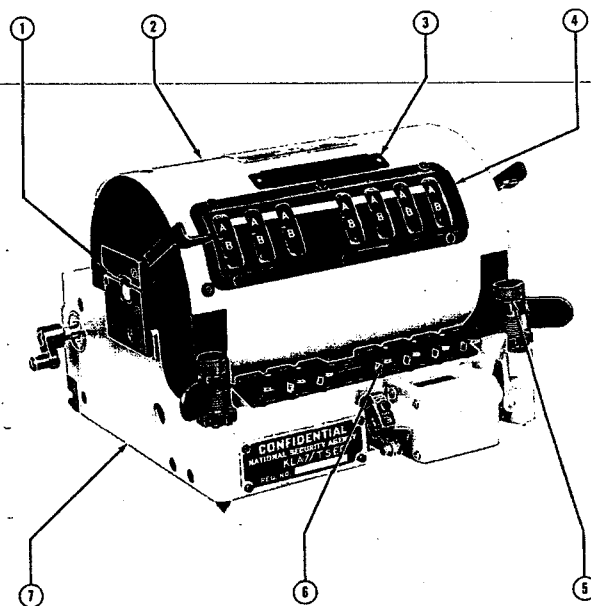


Fig. 4

- 1. Latch
- 2. Cipher Unit Assembly
- 3. Tape Holder
- 4. Frame
- 5. Screw Assembly
- 6. Set Key
- 7. Rotor Stepping Unit Assembly



~~CONFIDENTIAL~~

KAM-1/TSEC

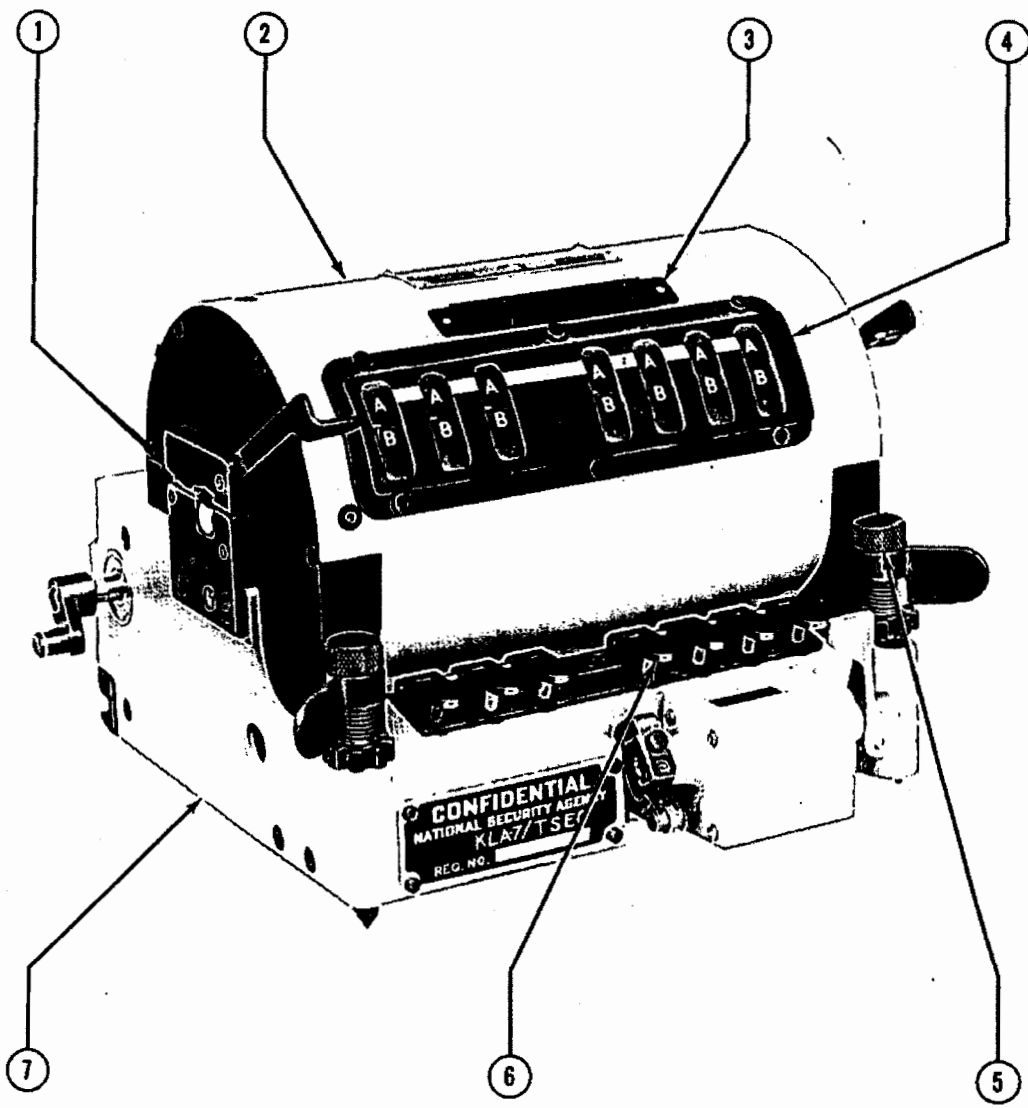


Fig. 4

- 1. Latch
- 2. Cipher Unit Assembly
- 3. Tape Holder
- 4. Frame
- 5. Screw Assembly
- 6. Set Key
- 7. Rotor Stepping Unit Assembly

~~CONFIDENTIAL~~

Folded Pages 175 and 176  
Contain  
Figure 5

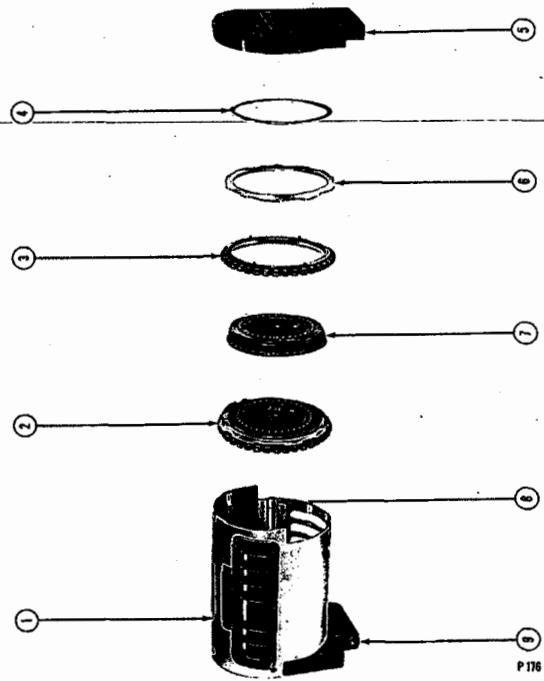


Fig. 5

- 1. Shell
- 2. Rotor Assembly
- 3. Alphabet Ring
- 4. Retaining Ring
- 5. Right-hand End Plate

- 6. Notch Ring
- 7. Rotor Core
- 8. Rotor Shaft
- 9. Left-hand End Plate

P 176

~~CONFIDENTIAL~~

KAM-1/TSEC

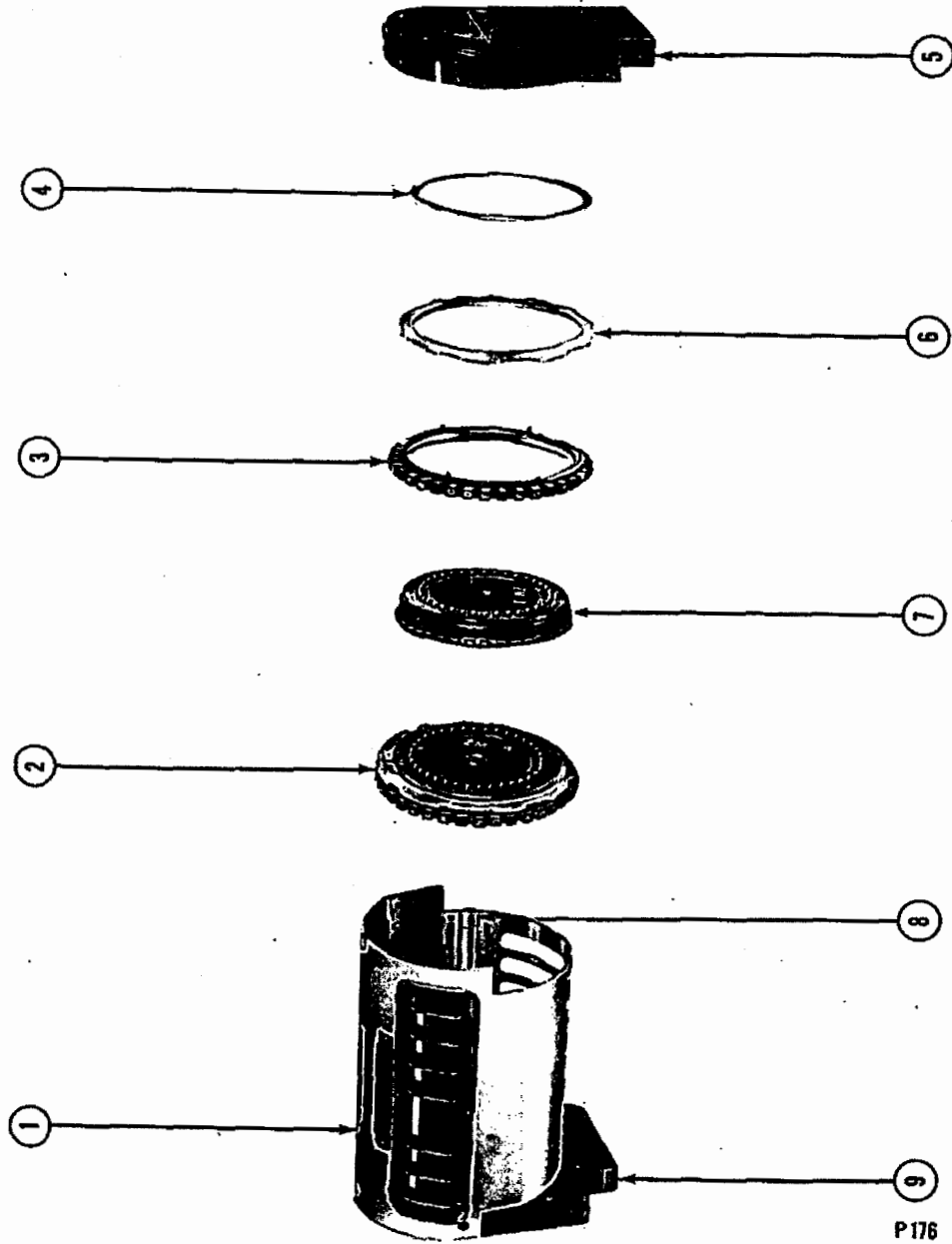


Fig. 5

- 1. Shell
- 2. Rotor Assembly
- 3. Alphabet Ring
- 4. Retaining Ring
- 5. Right-hand End Plate

- 6. Notch Ring
- 7. Rotor Core
- 8. Rotor Shaft
- 9. Left-hand End Plate

P176

~~CONFIDENTIAL~~

Folded Pages 177 and 178  
Contain  
Figure 6



Fig. 6

- |                                 |                      |
|---------------------------------|----------------------|
| 1. Connector                    | 5. Terminal Box      |
| 2. Cable                        | 6. Mounting Assembly |
| 3. Mounting Plate (not visible) | 7. Plywood Backboard |
| 4. TSEC/KL-7 Cable              |                      |

~~CONFIDENTIAL~~

KAM-1/TSEC

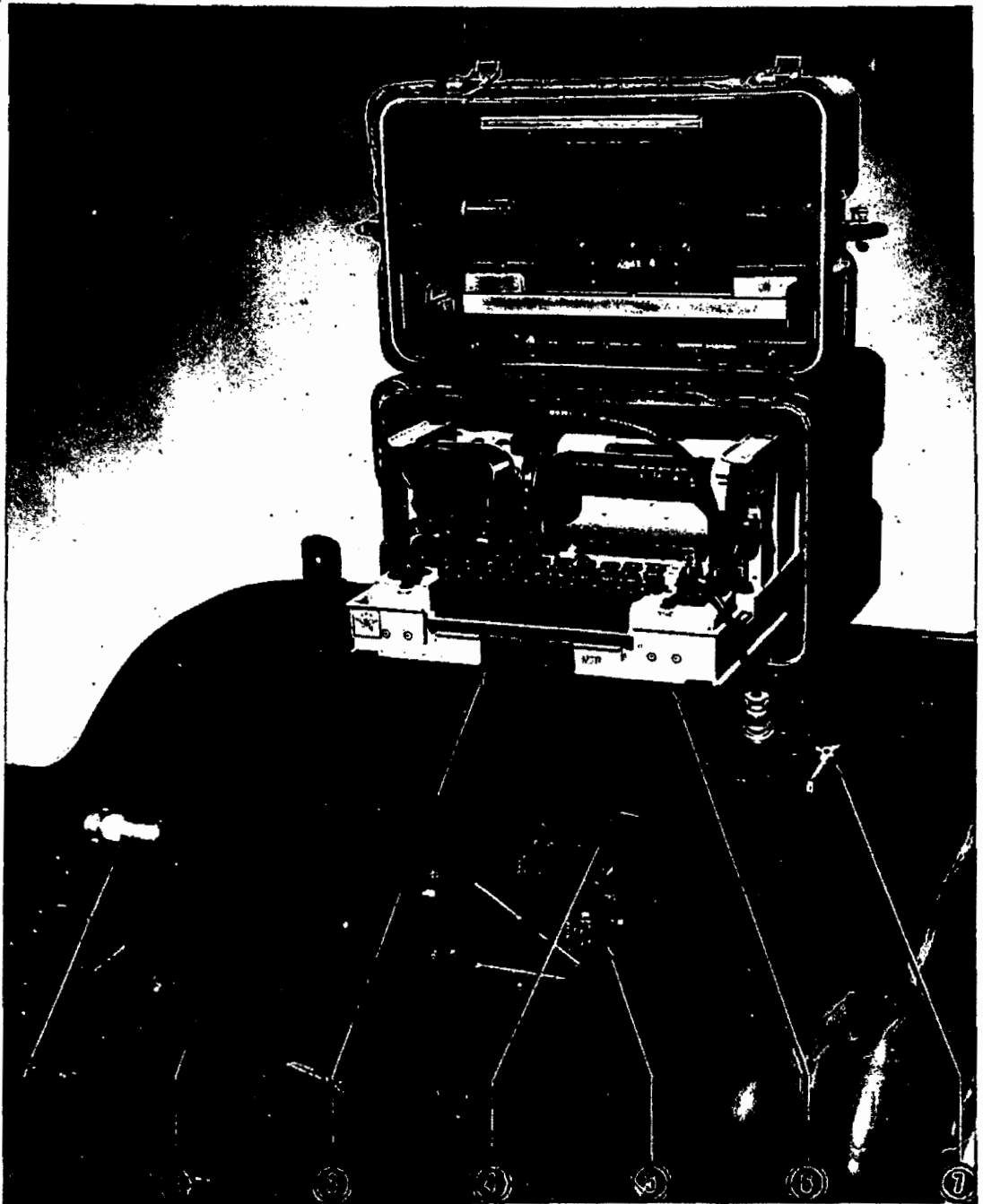


Fig. 6

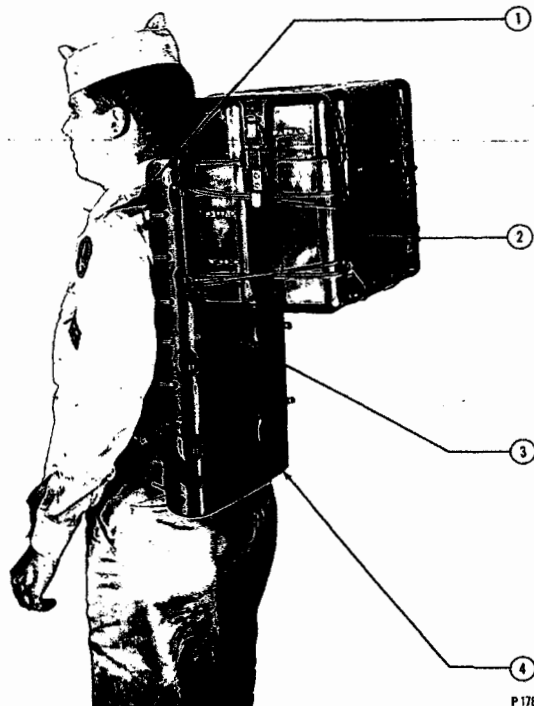
- |                                 |                      |
|---------------------------------|----------------------|
| 1. Connector                    | 5. Terminal Box      |
| 2. Cable                        | 6. Mounting Assembly |
| 3. Mounting Plate (not visible) | 7. Plywood Backboard |
| 4. TSEC/KL-7 Cable              |                      |

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Folded Pages 179 and 180  
Contain  
Figure 7



P 178

Fig. 7

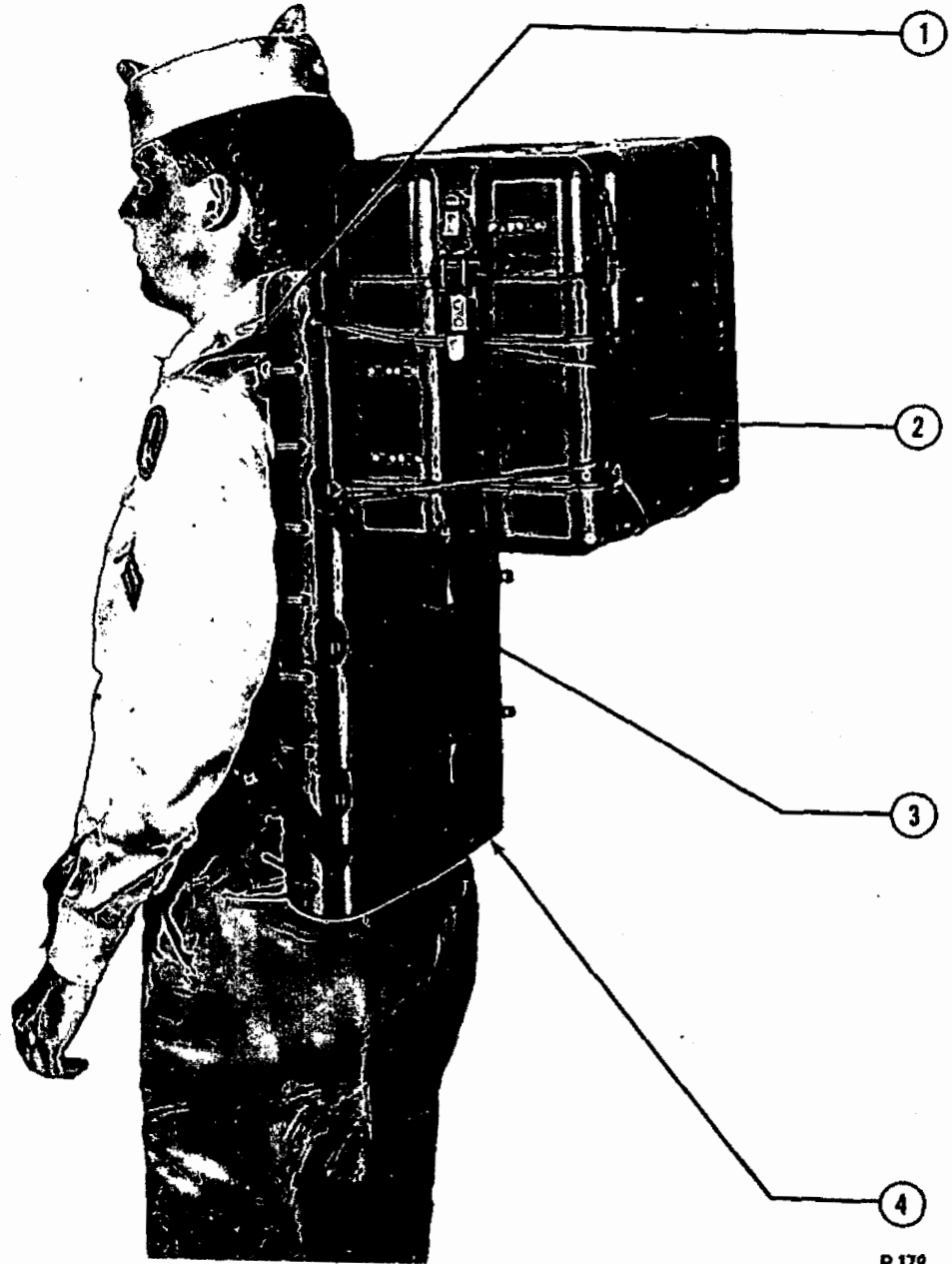
- 1. Shoulder Straps
- 2. Lashing Rope

- 3. Canvas
- 4. Packboard

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



P 178

Fig. 7

- 1. Shoulder Straps
- 2. Lashing Rope

- 3. Canvas
- 4. Packboard

~~CONFIDENTIAL~~

Folded Pages 181 and 182  
Contain  
Figure 8

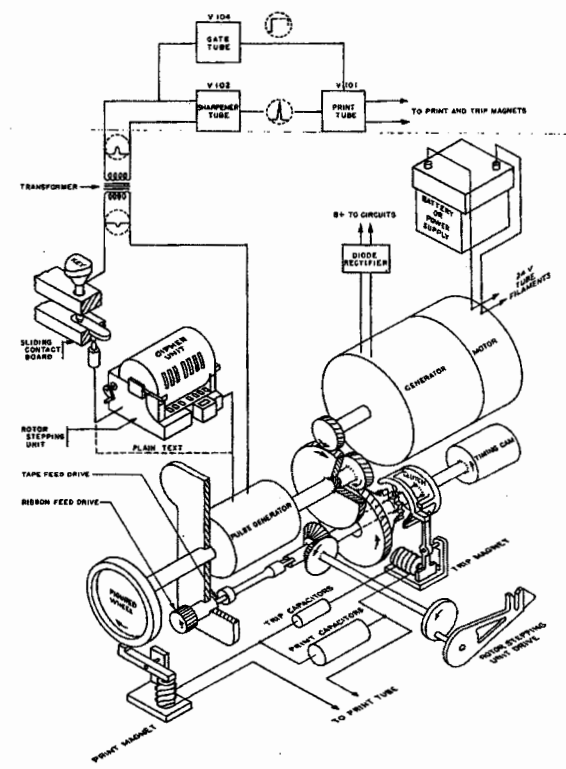


Fig. 8



~~CONFIDENTIAL~~

KAM-1/TSEC

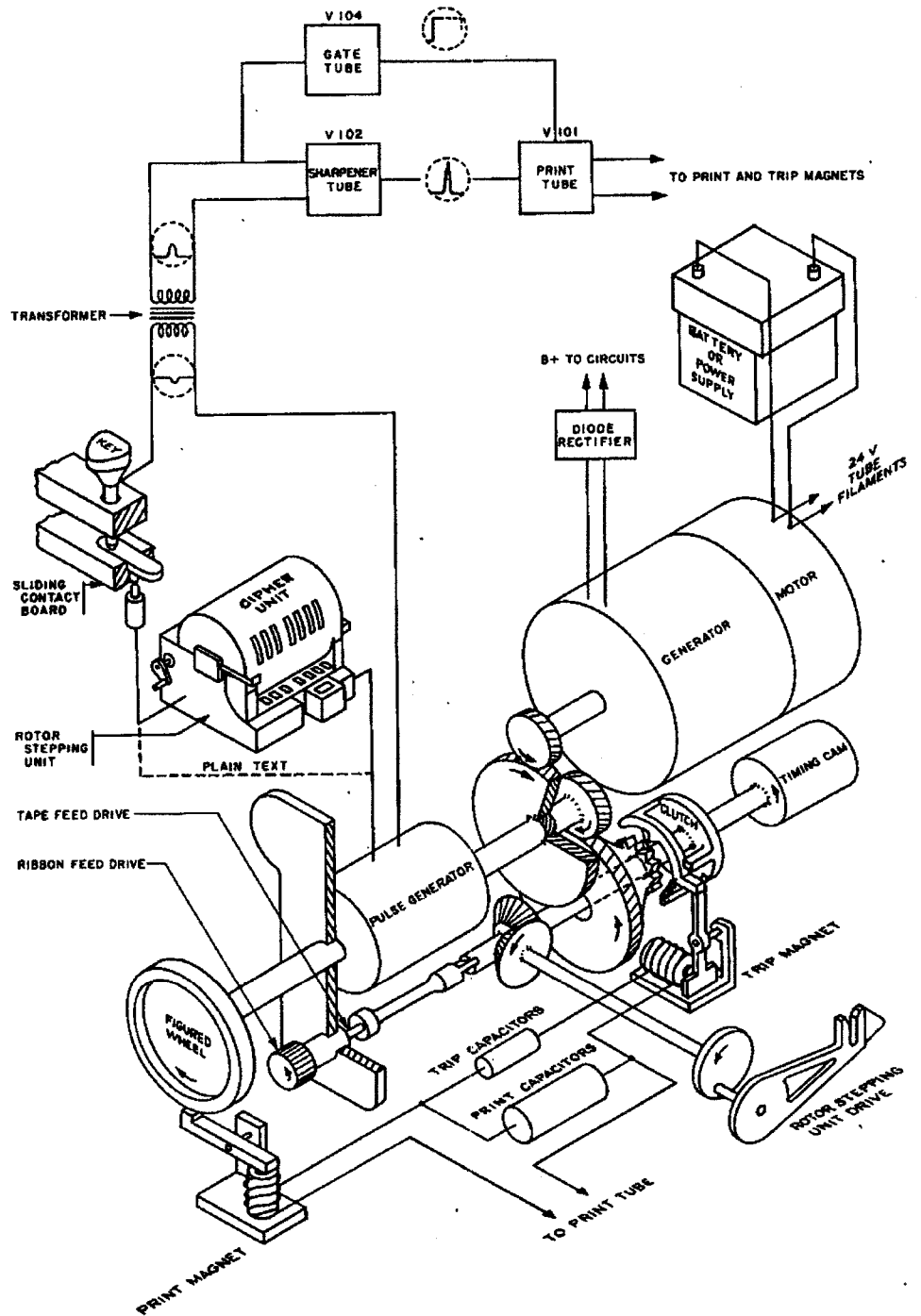


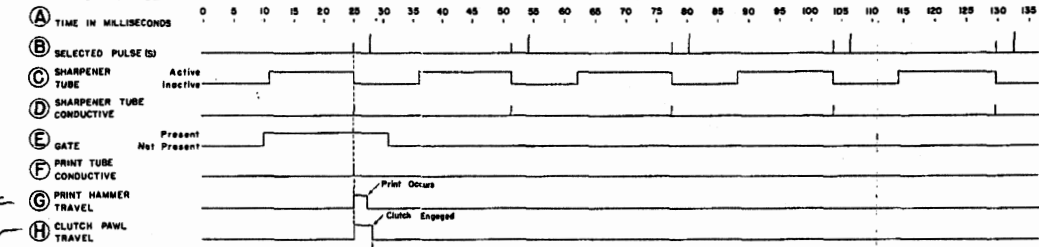
Fig. 8

~~CONFIDENTIAL~~

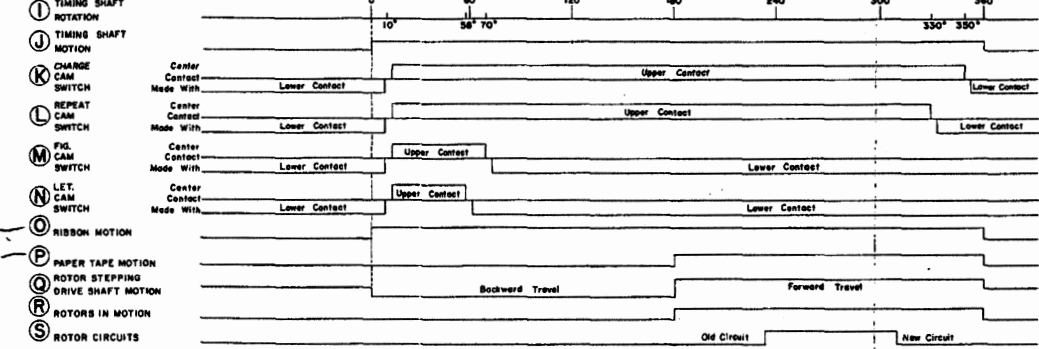
ORIGINAL

Folded Pages 183 and 184  
Contain  
Figure 9

PRINTING PHASE



STEPPING PHASE



REFER TO PARAGRAPH 2104 FOR DETAILED EXPLANATION

CONFIDENTIAL

CONFIDENTIAL

183

Fig. 9

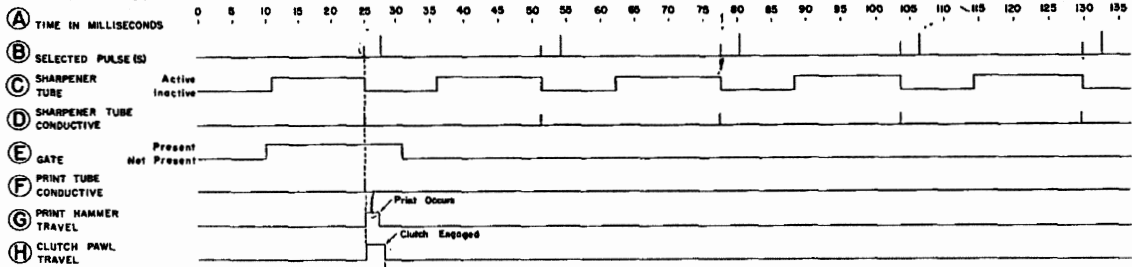
Change No. 1

KAM-1/TSEC

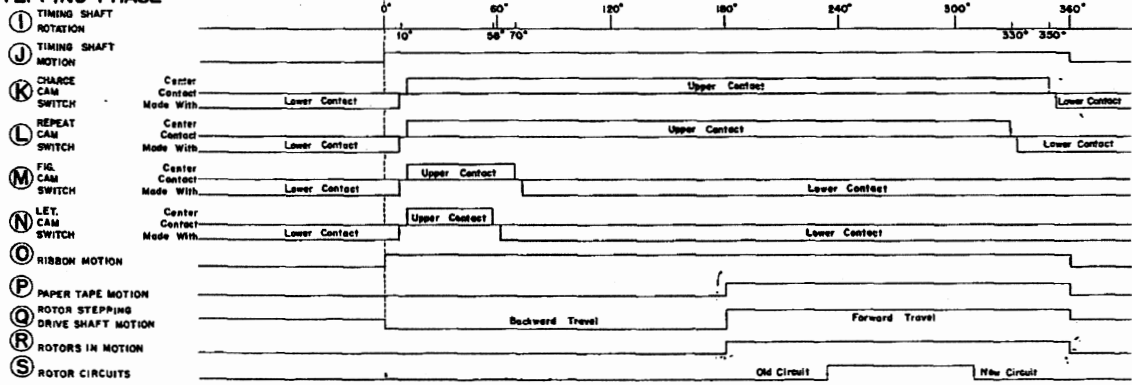
CONFIDENTIAL

CONFIDENTIAL

PRINTING PHASE



STEPPING PHASE



REFER TO PARAGRAPH 2104 FOR DETAILED EXPLANATION

Fig. 9

184

Change No. 1

KAM-1/TSEC

~~CONFIDENTIAL~~

KAM-1/TSEC

Folded Pages 185 and 186  
Contain  
Figure 10

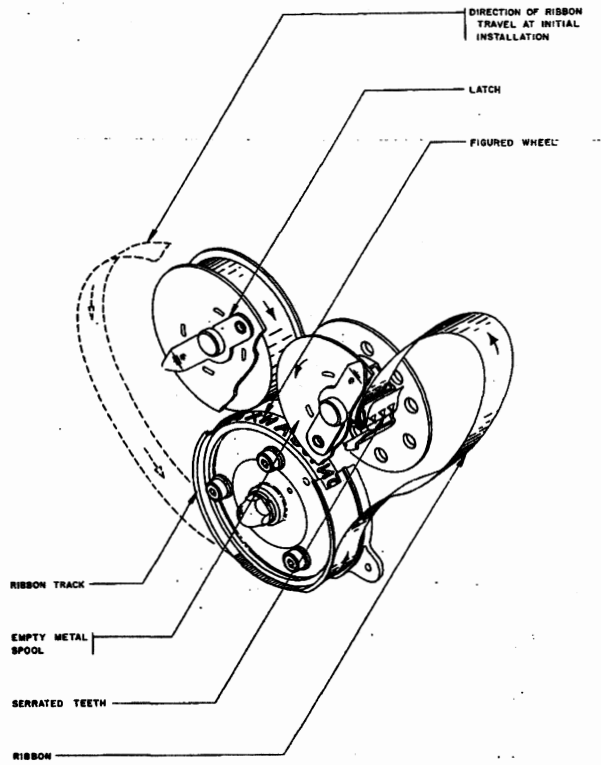


Fig. 10

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

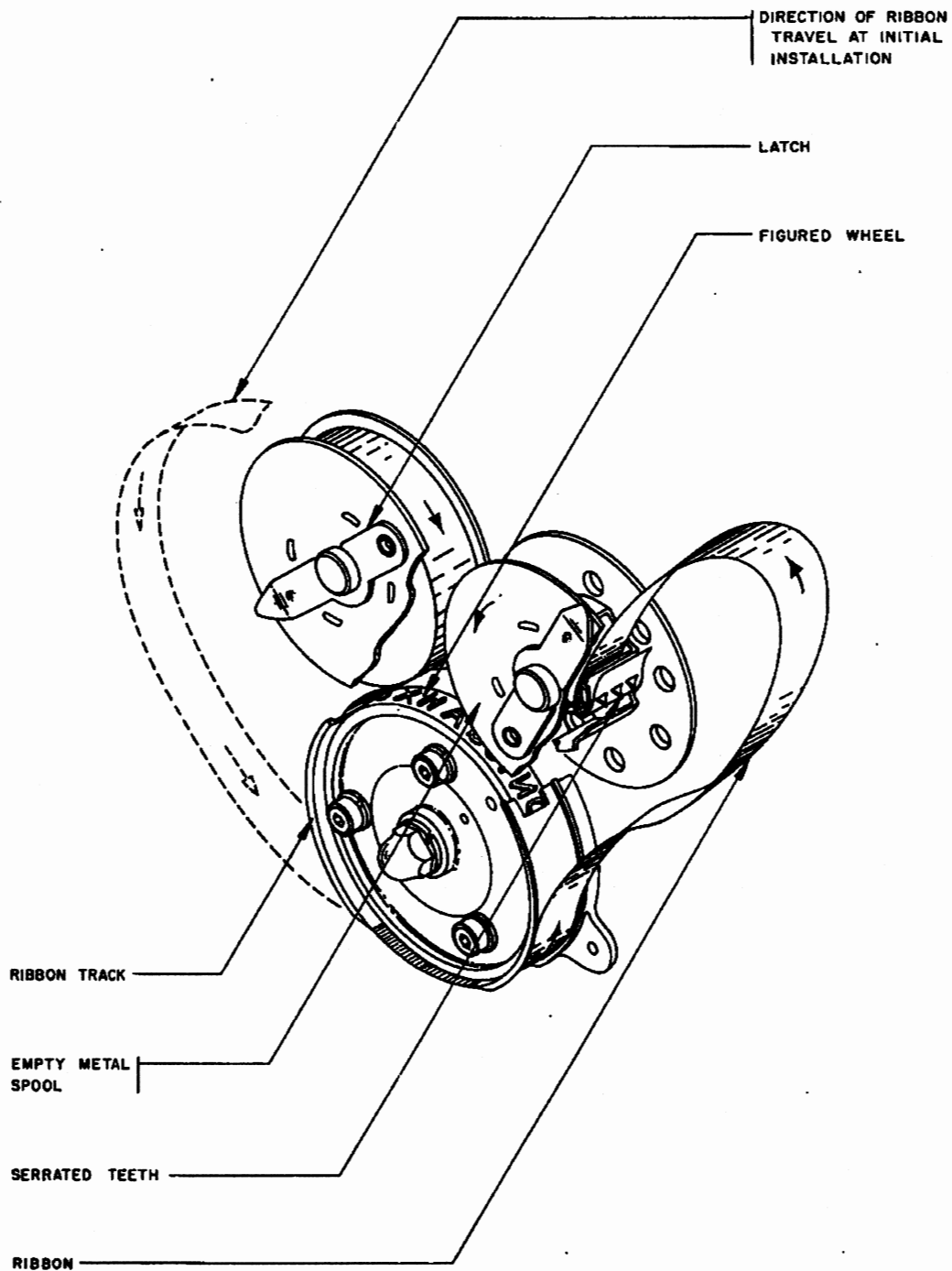


Fig. 10

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

Folded Pages 187 and 188  
Contain  
Figure 11

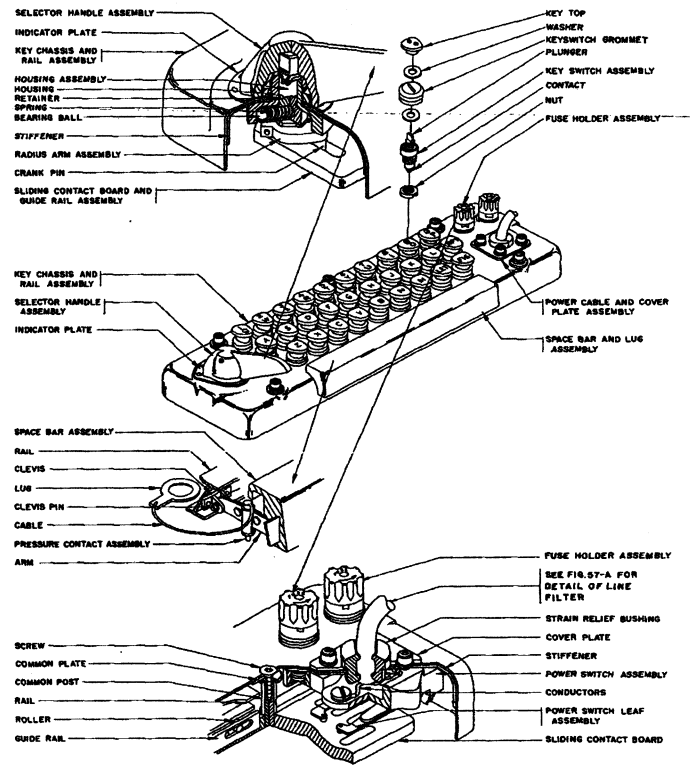


Fig. 11

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

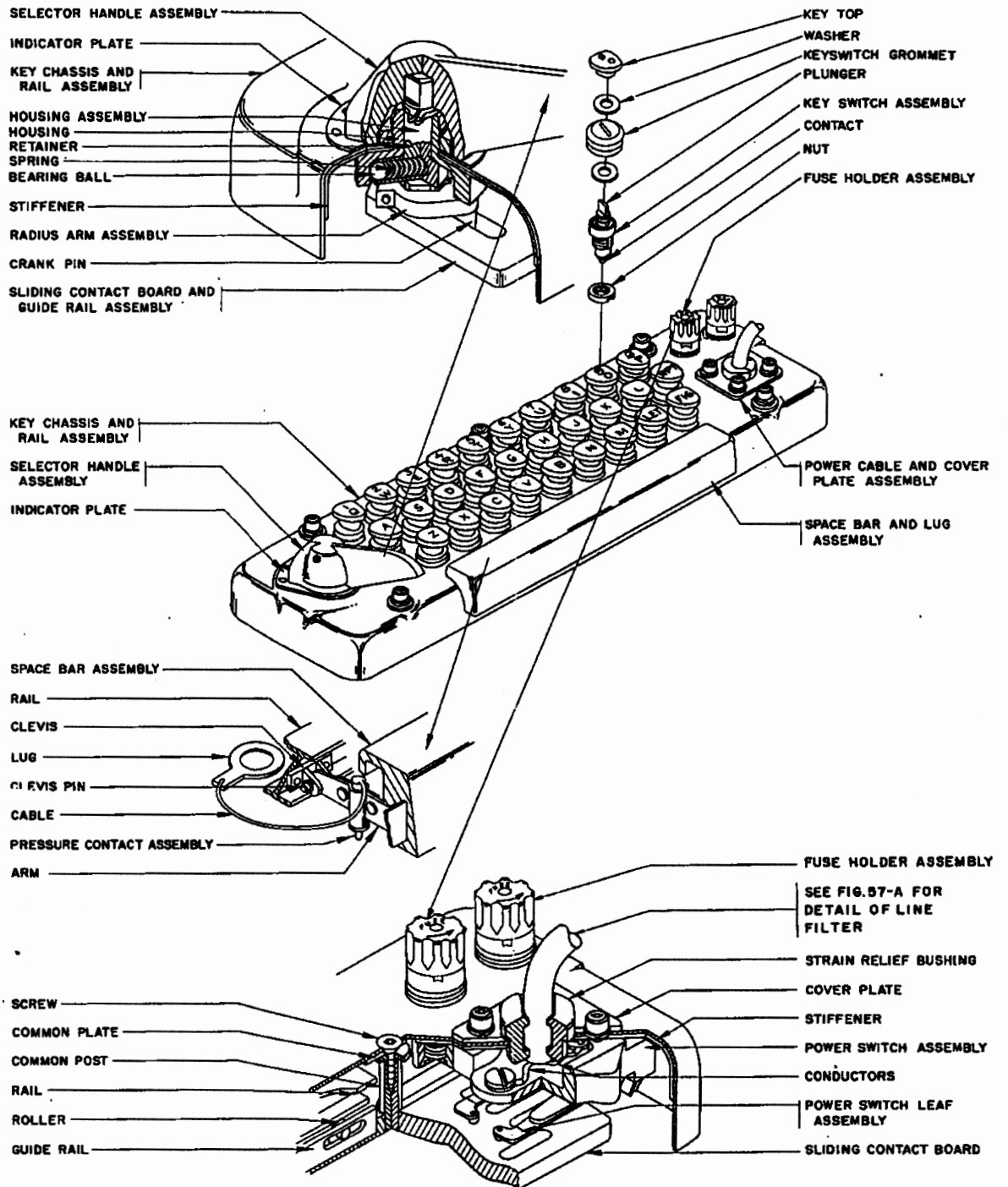


Fig. 11

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Folded Pages 189 and 190  
Contain  
Figure 12

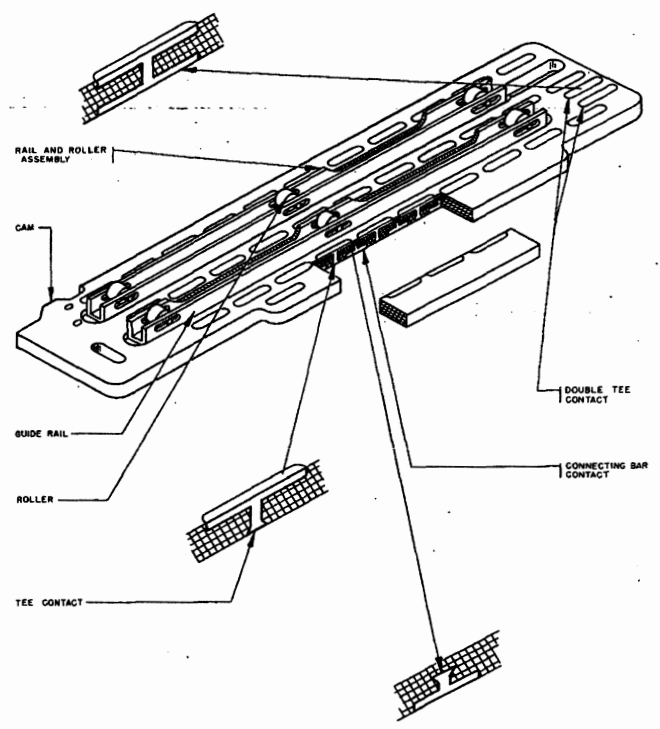


Fig. 12

~~CONFIDENTIAL~~

ORIGINAL



~~CONFIDENTIAL~~

KAM-1/TSEC

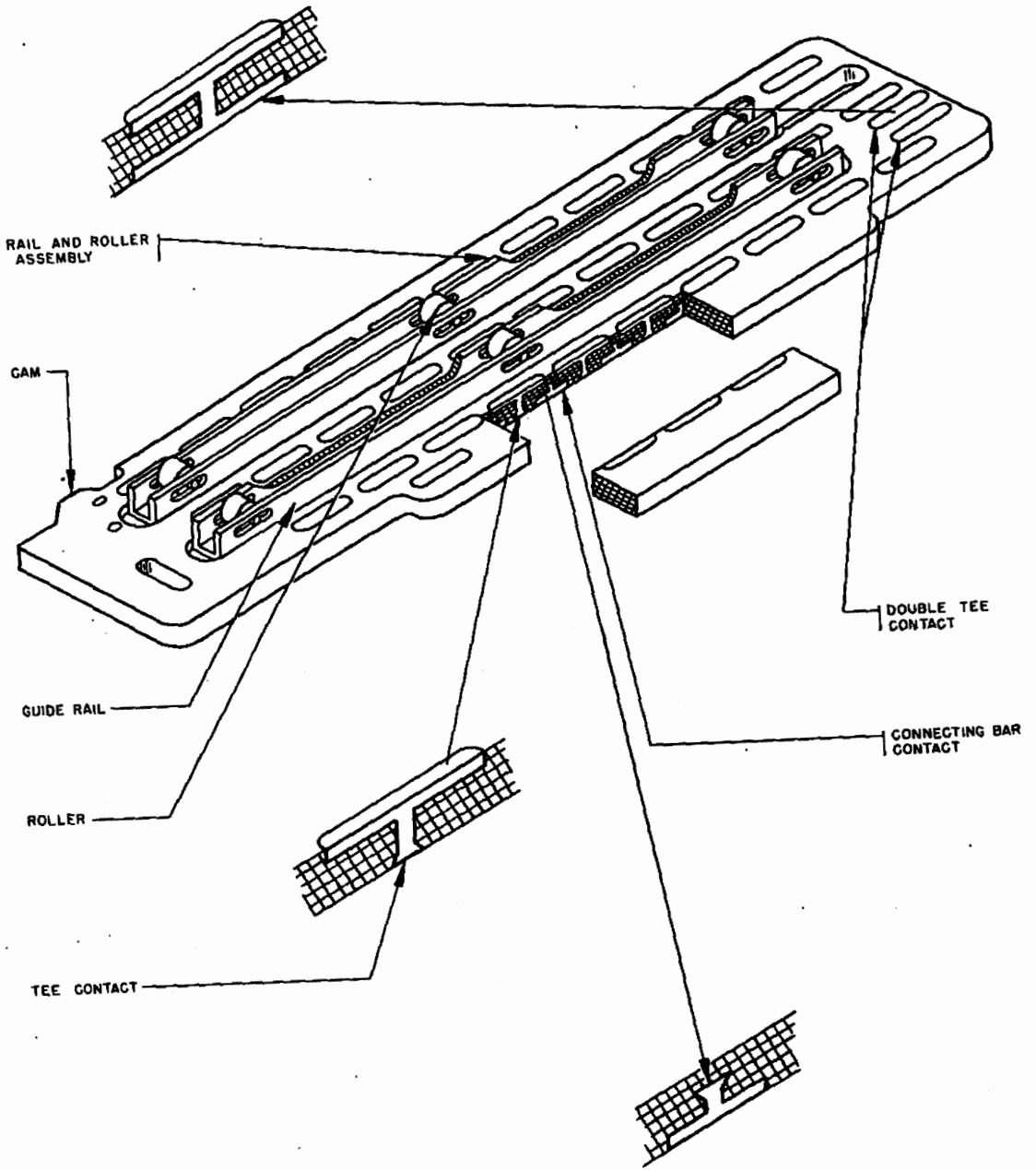


Fig. 12

~~CONFIDENTIAL~~

ORIGINAL

Folded Pages 191 and 192  
Contain  
Figure 13

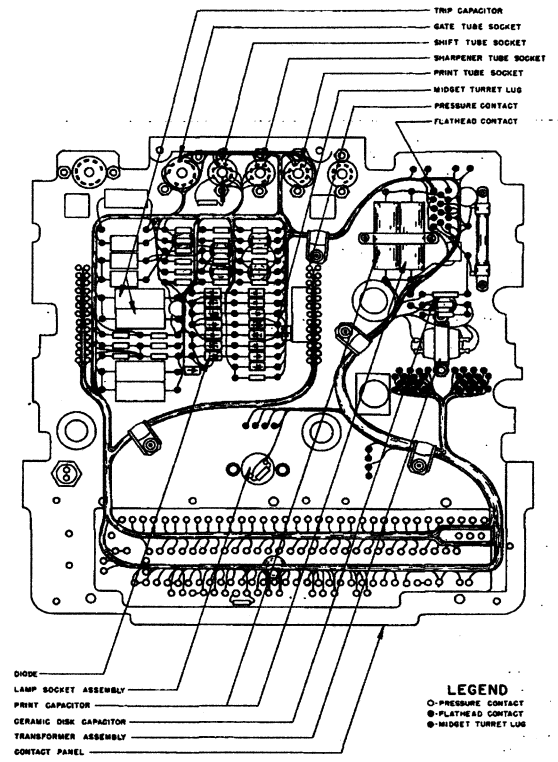


Fig. 13

~~CONFIDENTIAL~~

KAM-1/TSEC

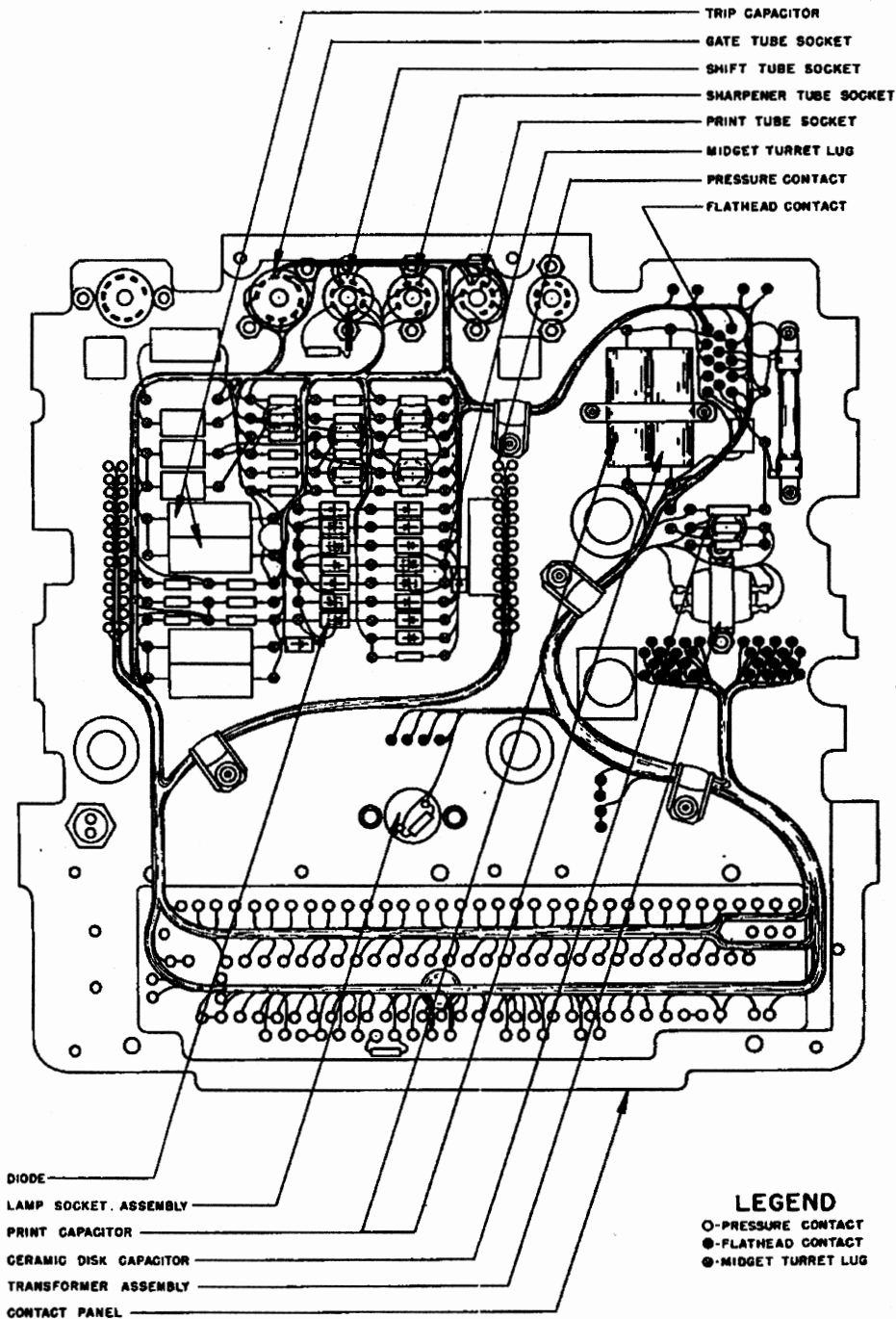


Fig. 13

~~CONFIDENTIAL~~

ORIGINAL

Folded Pages 193 and 194  
Contain  
Figure 14

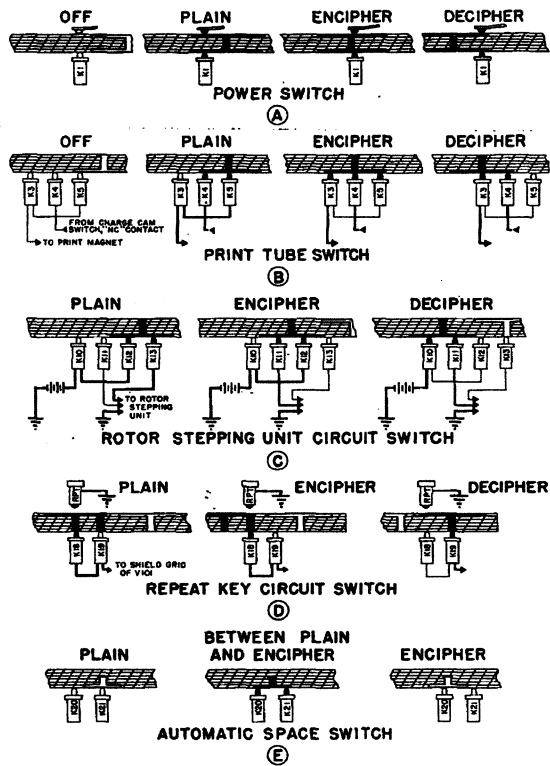
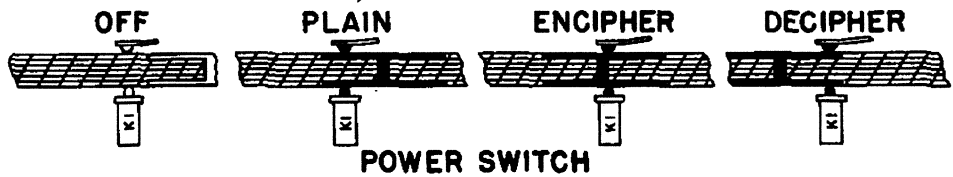


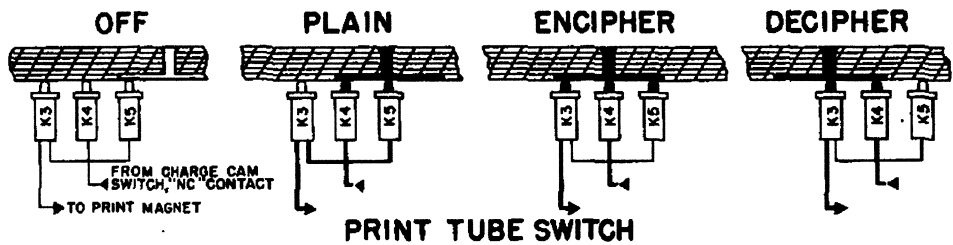
Fig. 14

~~CONFIDENTIAL~~

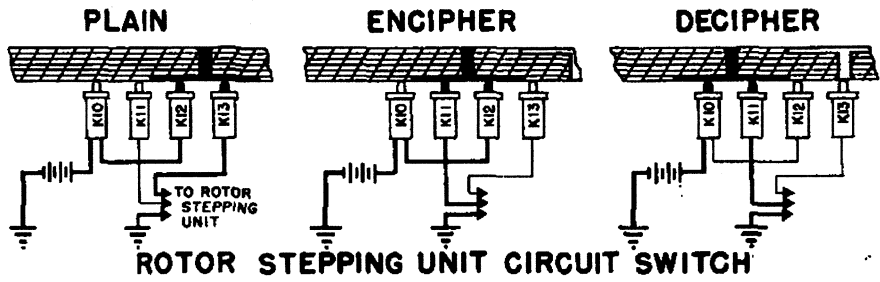
KAM-1/TSEC



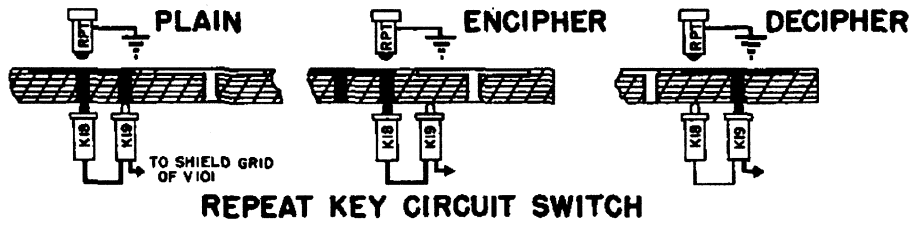
(A)



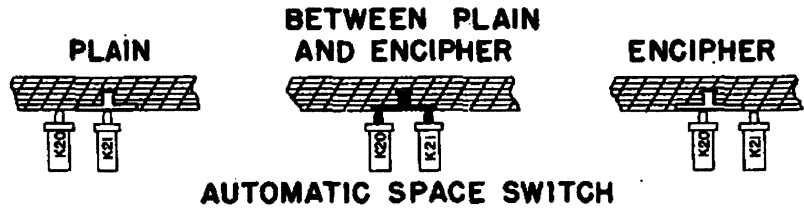
(B)



(C)



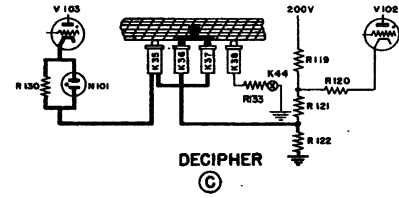
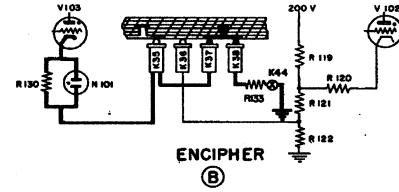
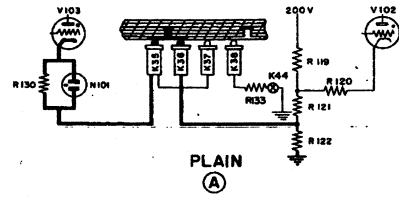
(D)



(E)

Fig. 14

~~CONFIDENTIAL~~

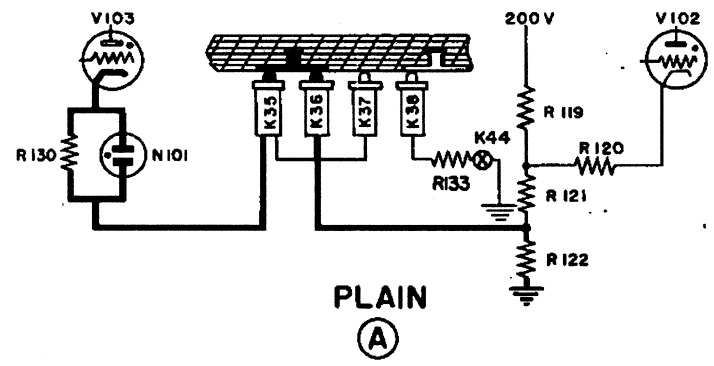


Folded Pages 195 and 196  
Contain  
Figure 15

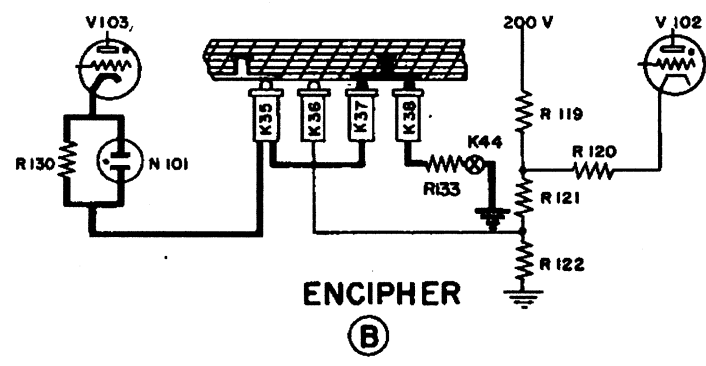
Fig. 15

~~CONFIDENTIAL~~

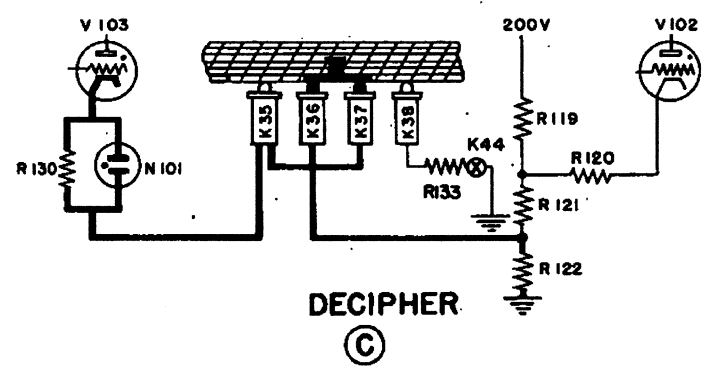
KAM-1/TSEC



PLAIN  
(A)



ENCIPHER  
(B)



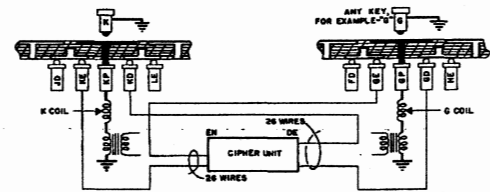
DECIPHER  
(C)

Fig. 15

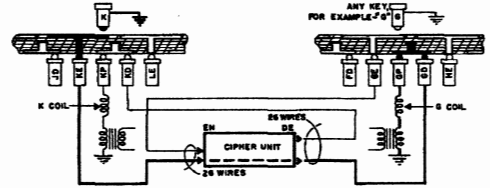
~~CONFIDENTIAL~~

ORIGINAL

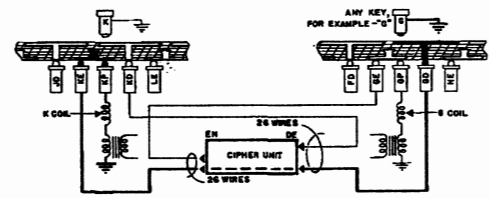
Folded Pages 197 and 198  
Contain  
Figure 16



PLAIN  
(A)



ENCIPHER  
(B)



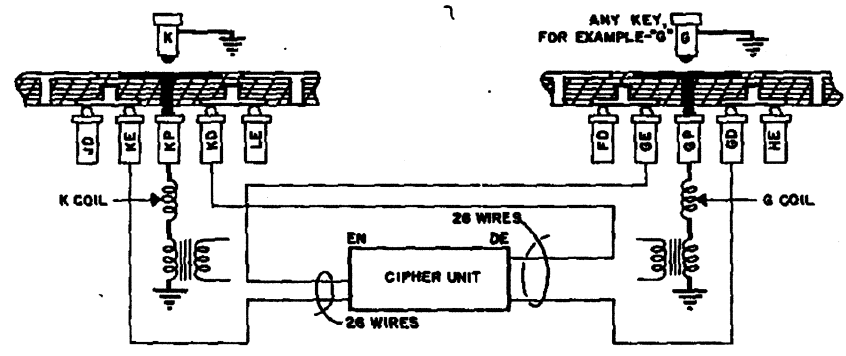
DECIPHER  
(C)

Fig. 16



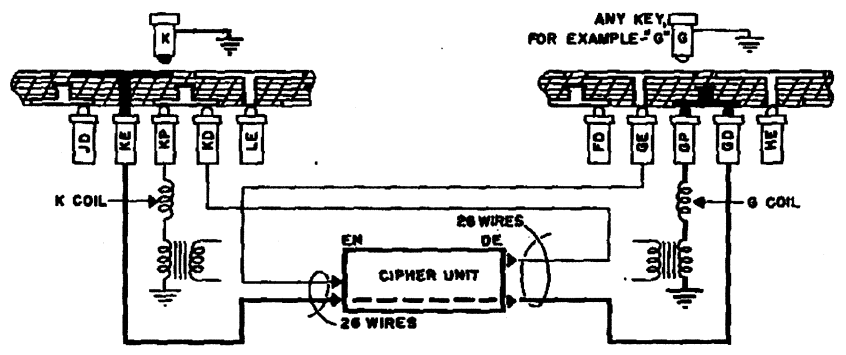
~~CONFIDENTIAL~~

KAM-1/TSEC



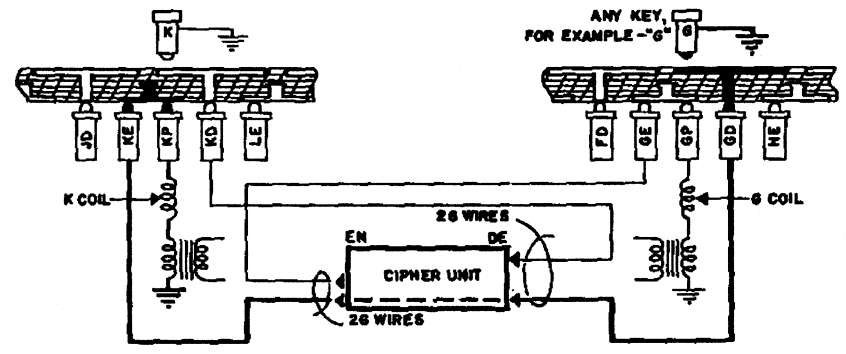
PLAIN

(A)



ENCIPHER

(B)



DECIPHER

(C)

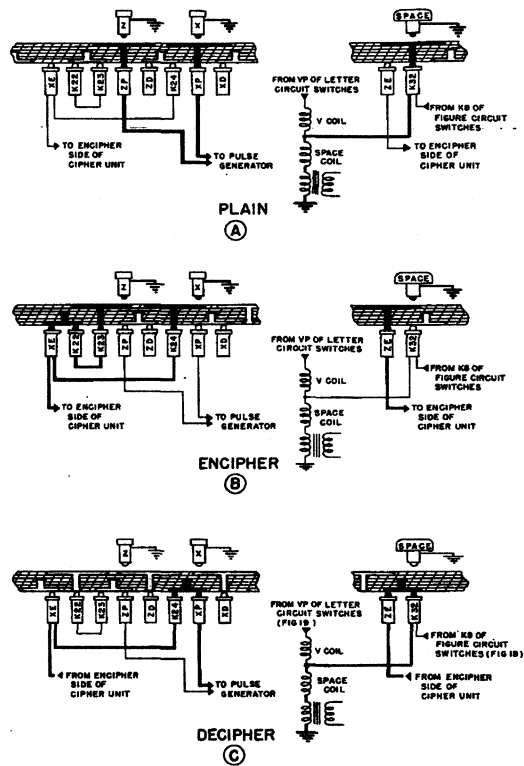
Fig. 16

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC



Folded Pages 199 and 200  
Contain  
Figure 17

Fig. 17

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

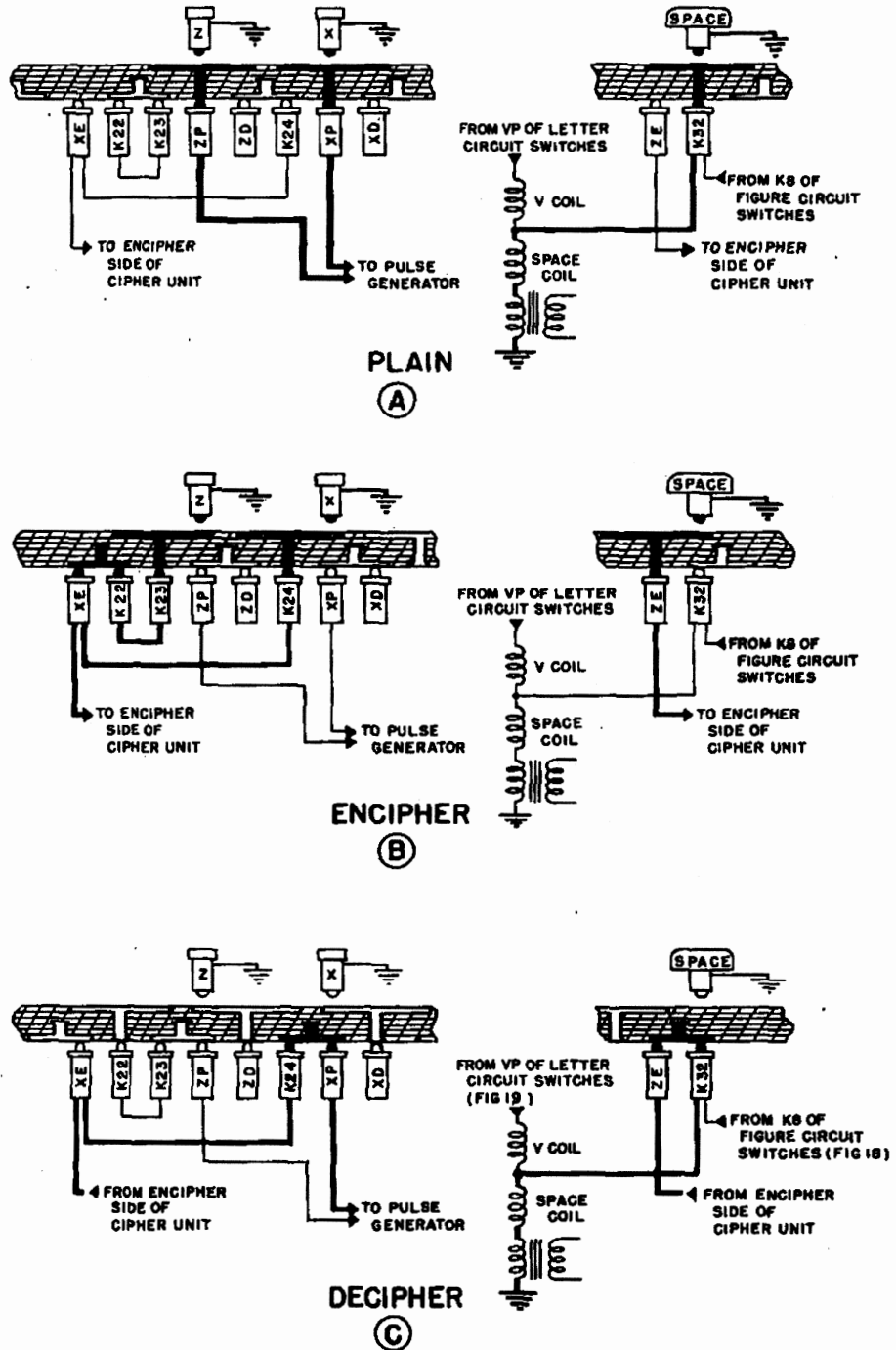


Fig. 17

~~CONFIDENTIAL~~

ORIGINAL

Folded Pages 201 and 202  
Contain  
Figure 18

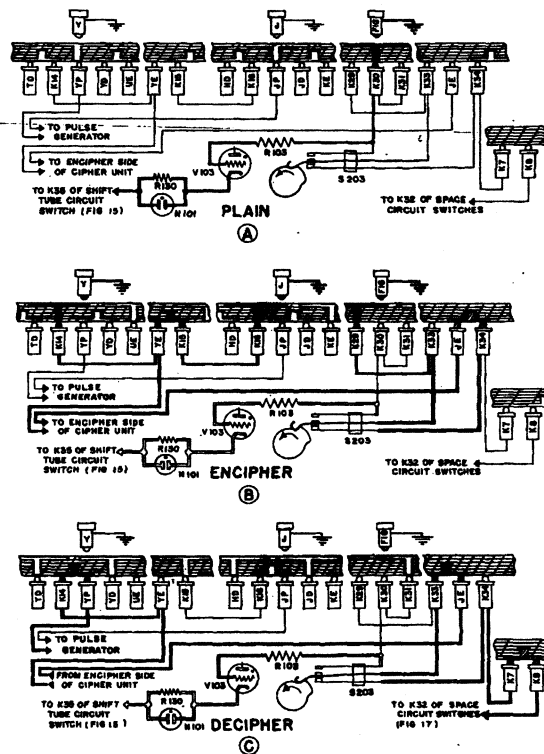


Fig. 18

~~CONFIDENTIAL~~

KAM-1/TSEC

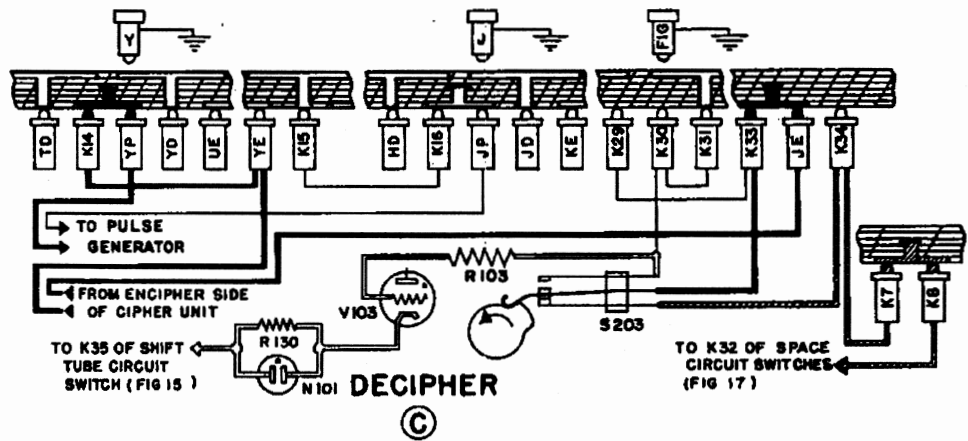
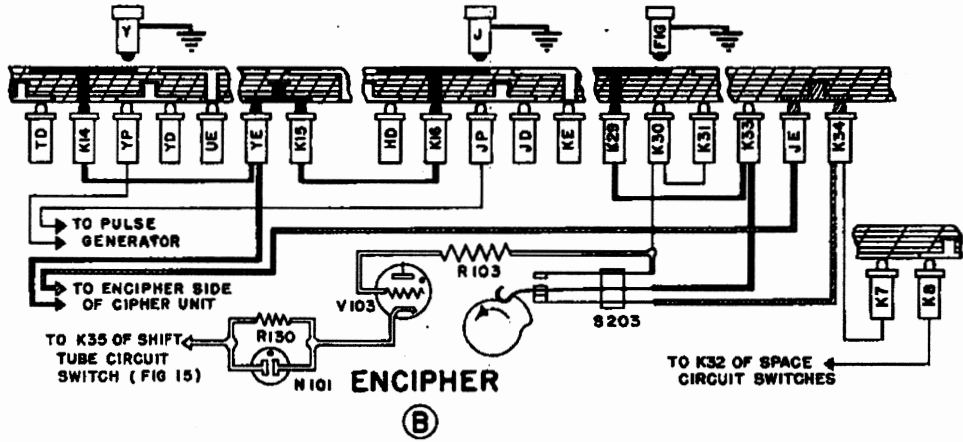
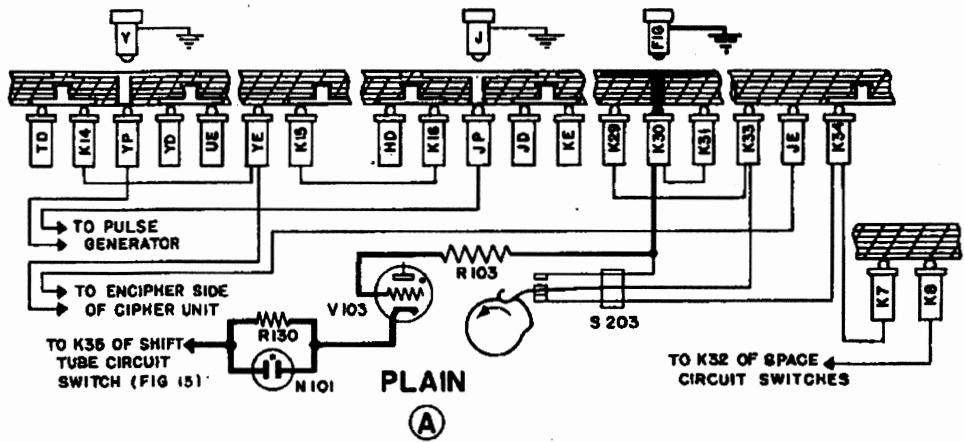
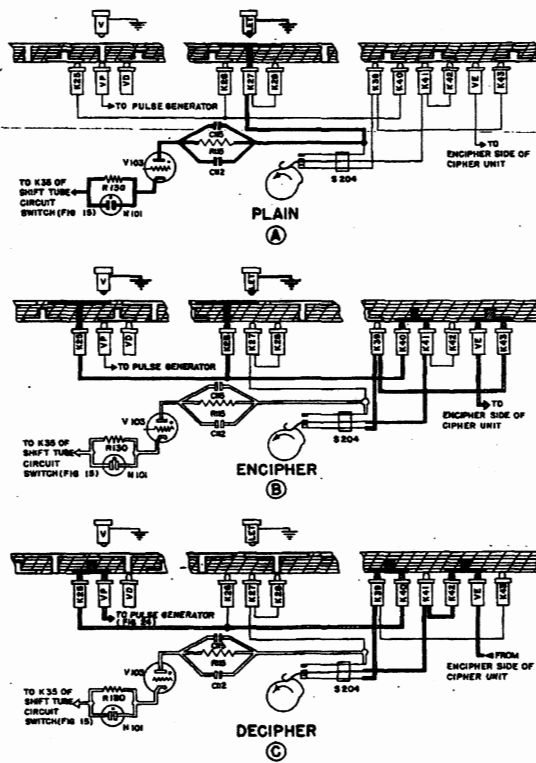


Fig. 18

~~CONFIDENTIAL~~

ORIGINAL



Folded Pages 203 and 204  
Contain  
Figure 19

Fig. 19

~~CONFIDENTIAL~~

KAM-1/TSEC

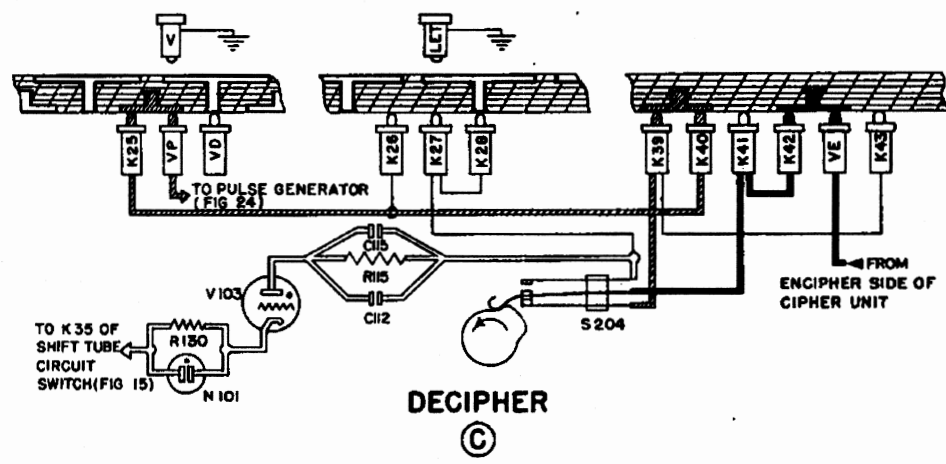
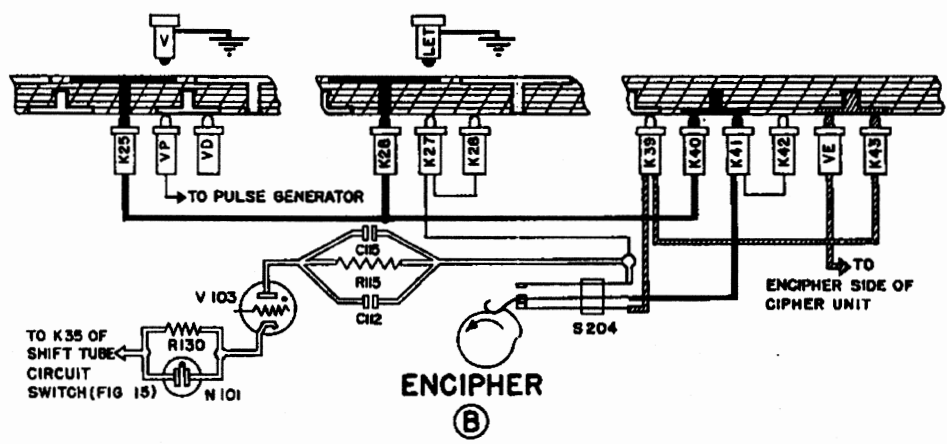
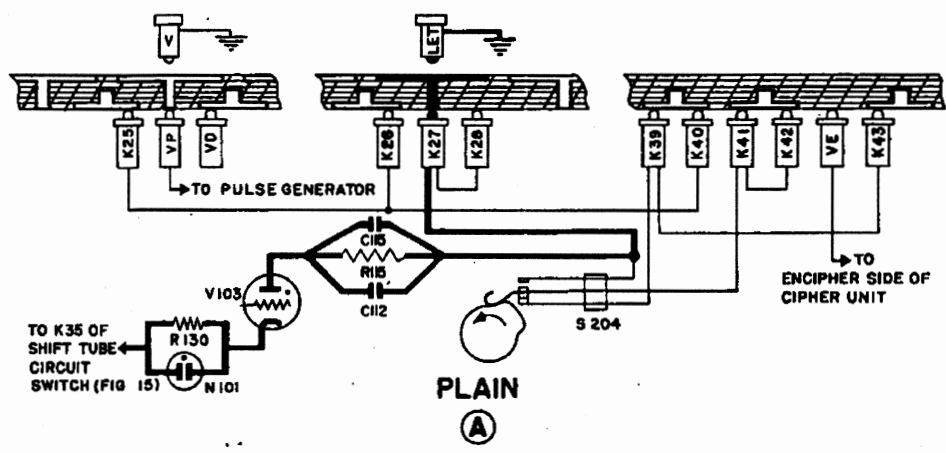
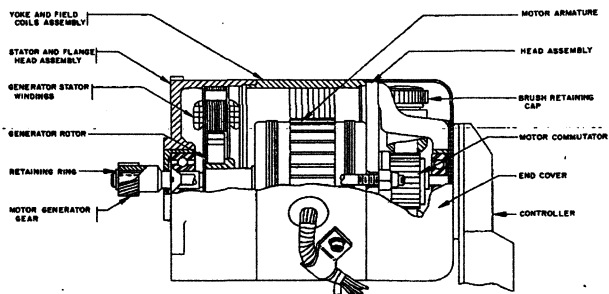


Fig. 19

~~CONFIDENTIAL~~

ORIGINAL



Folded Pages 205 and 206  
Contain  
Figure 20

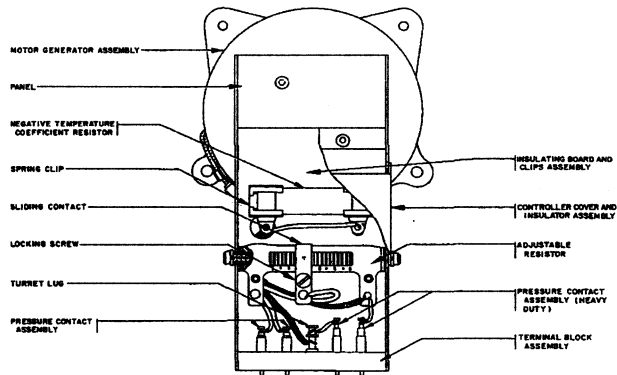


Fig. 20



~~CONFIDENTIAL~~

KAM-1/TSEC

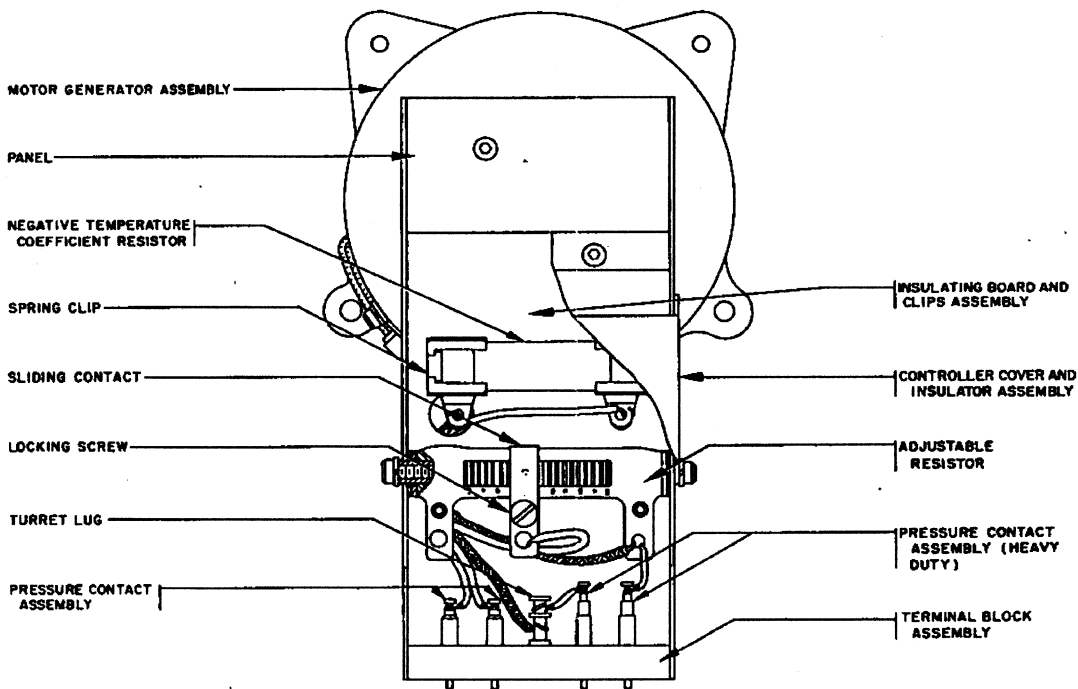
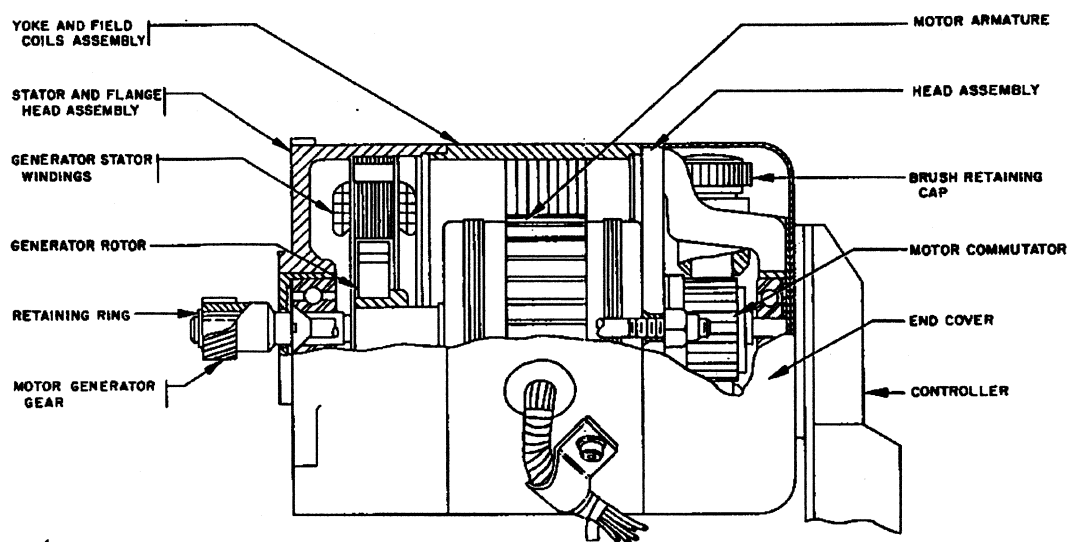
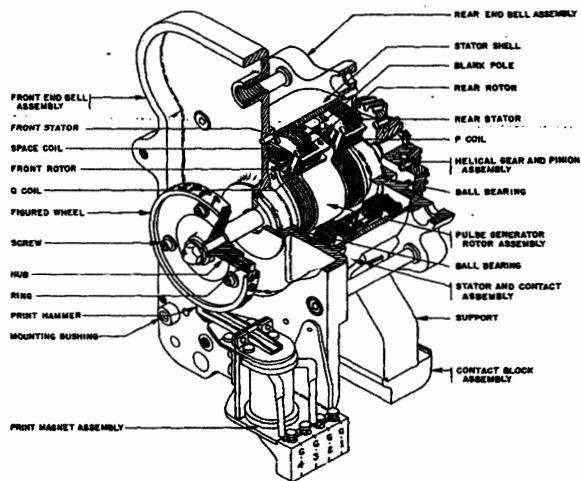


Fig. 20

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



Folded Pages 207 and 208  
 Contain  
 Figure 21

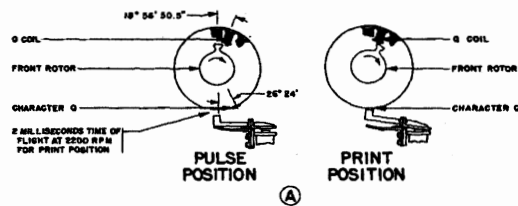


Fig. 21

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

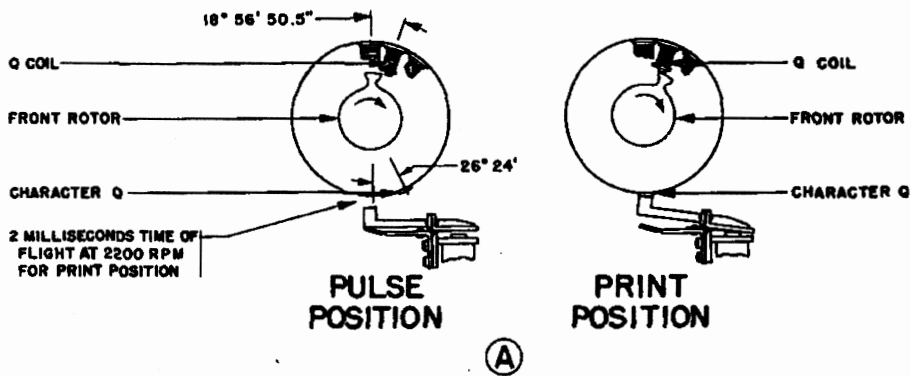
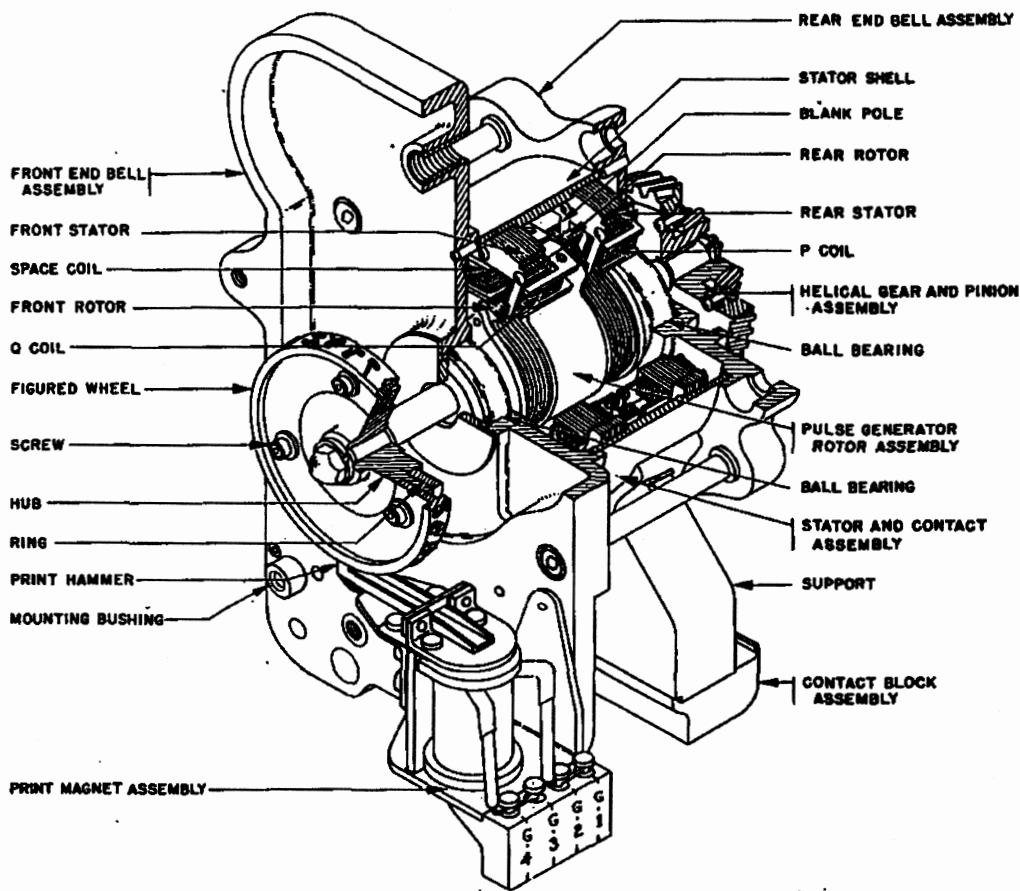


Fig. 21

~~CONFIDENTIAL~~

Folded Pages 209 and 210  
Contain  
Figure 22

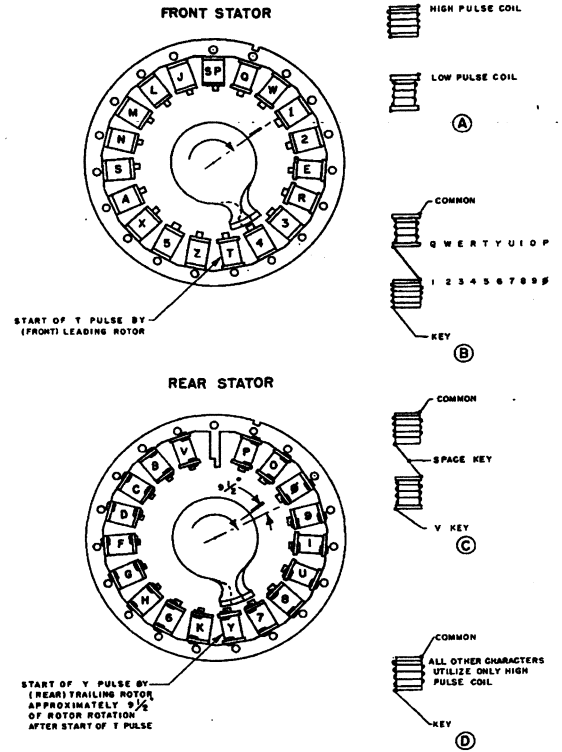
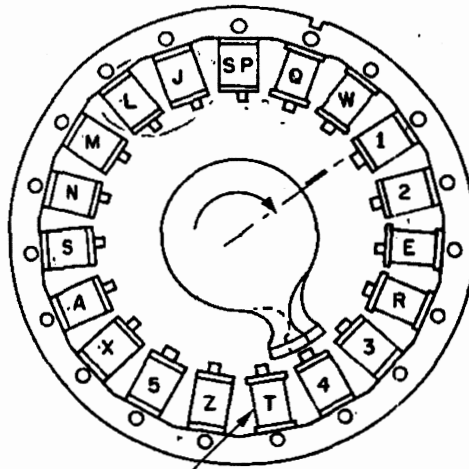


Fig. 22

~~CONFIDENTIAL~~

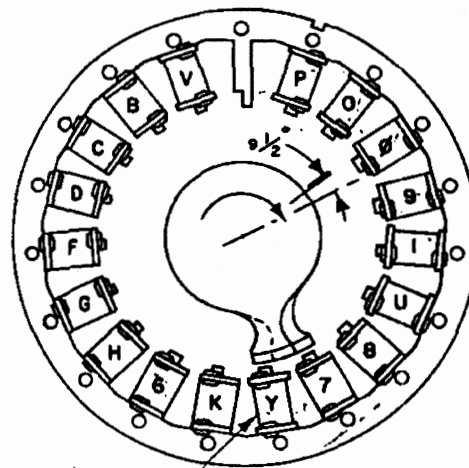
KAM-1/TSEC

FRONT STATOR



START OF T PULSE BY  
(FRONT) LEADING ROTOR

REAR STATOR



START OF Y PULSE BY  
(REAR) TRAILING ROTOR  
APPROXIMATELY 9/2  
OF ROTOR ROTATION  
AFTER START OF T PULSE

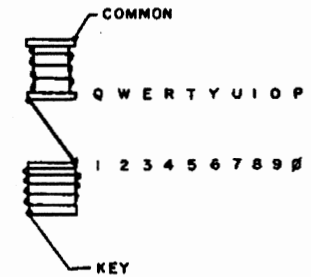


HIGH PULSE COIL

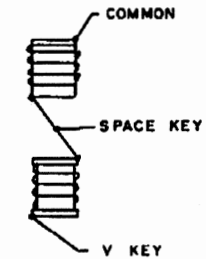


LOW PULSE COIL

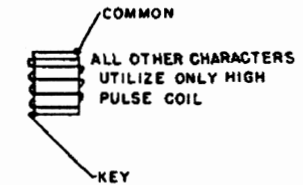
(A)



(B)



(C)



(D)

Fig. 22

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

Folded Pages 211 and 212  
Contain  
Figure 23

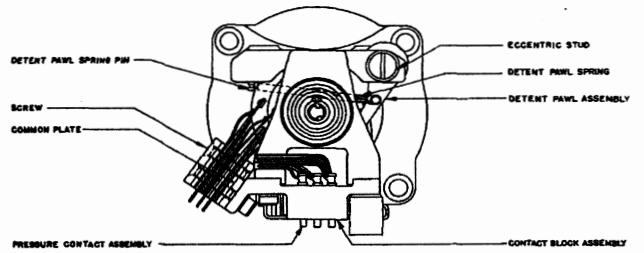
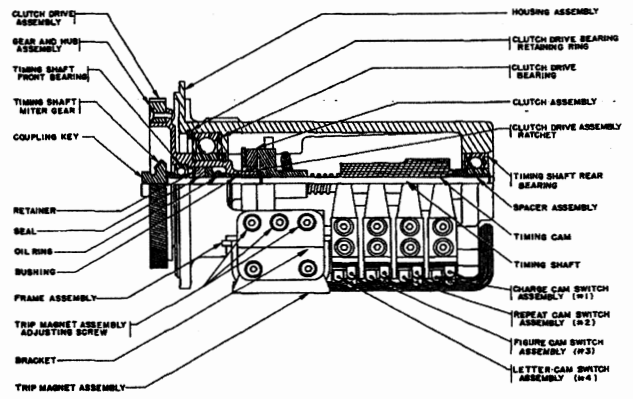


Fig. 23

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

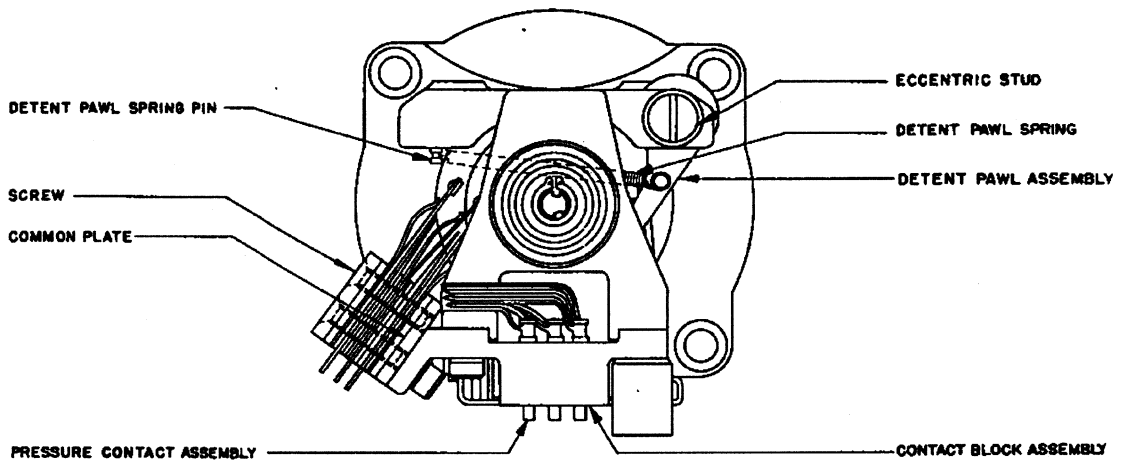
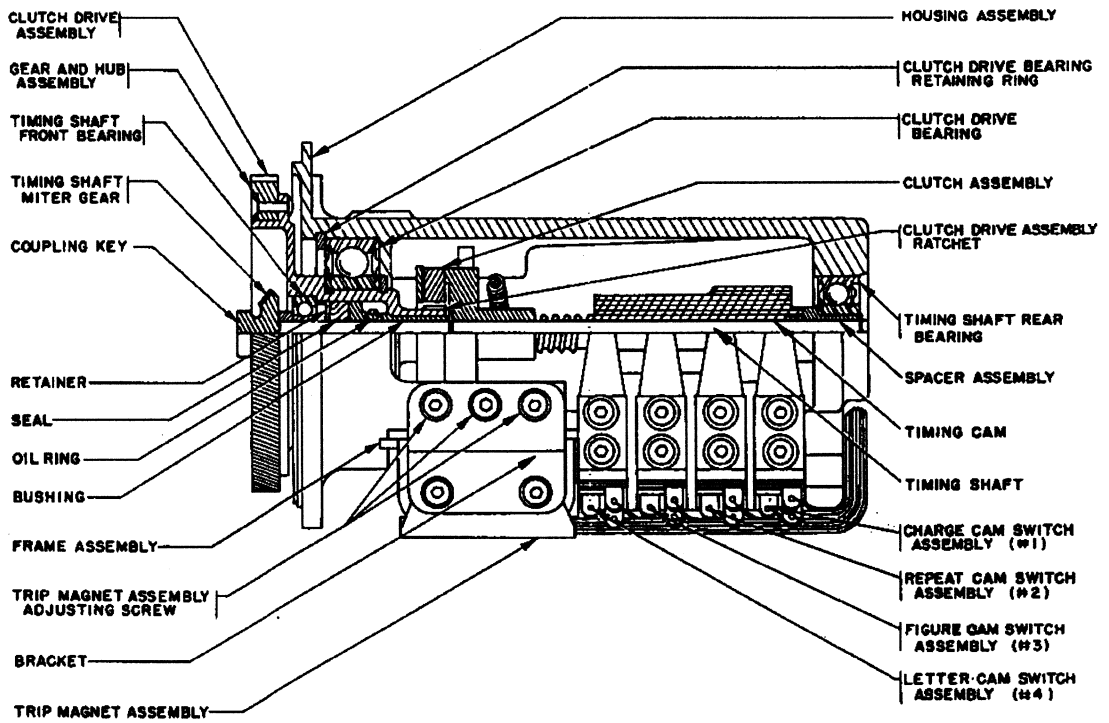
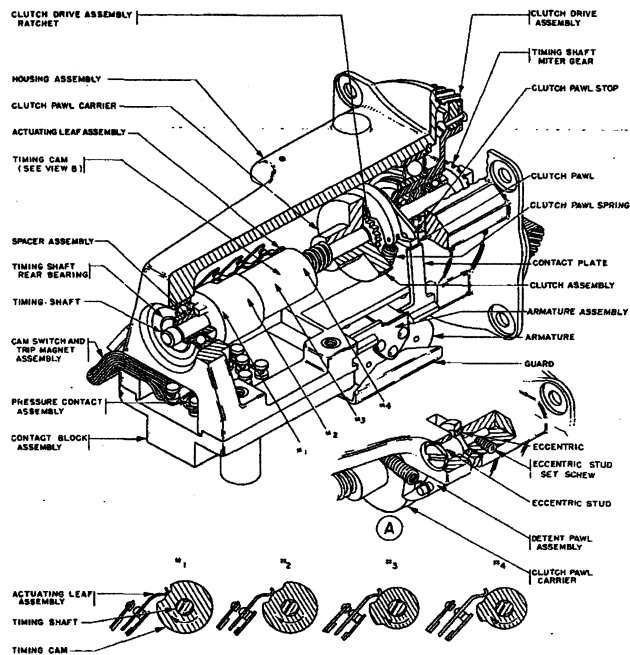


Fig. 23

~~CONFIDENTIAL~~

ORIGINAL

Folded Pages 213 and 214  
Contain  
Figure 24



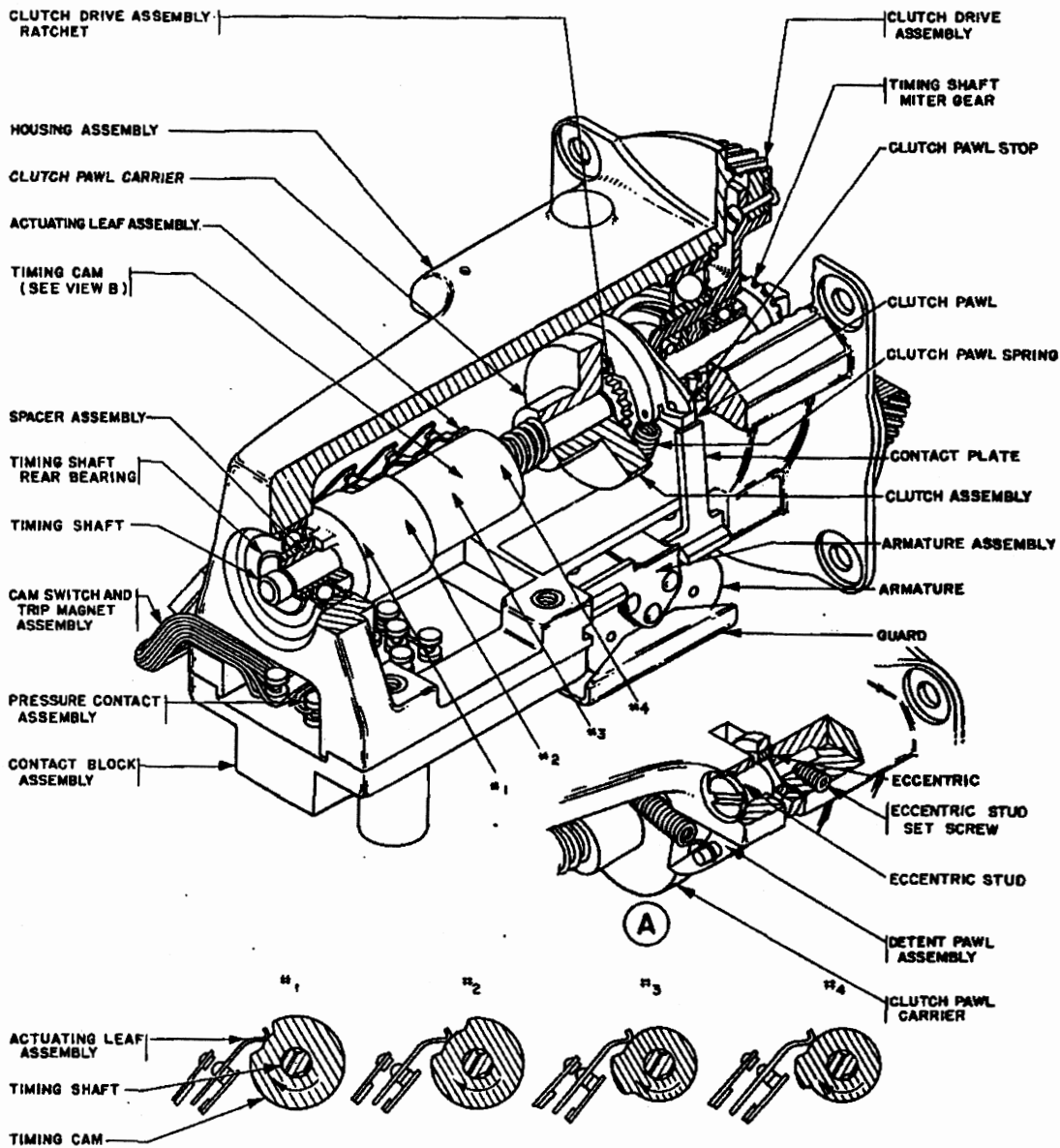
APPROXIMATE POSITION OF CAM SWITCH CONTACTS WITH CLUTCH DISENGAGED  
(B)

Fig. 24



~~CONFIDENTIAL~~

KAM-1/TSEC



APPROXIMATE POSITION OF CAM SWITCH CONTACTS WITH CLUTCH DISENGAGED

(B)

Fig. 24

~~CONFIDENTIAL~~

ORIGINAL

Folded Pages 215 and 216  
Contain  
Figure 25

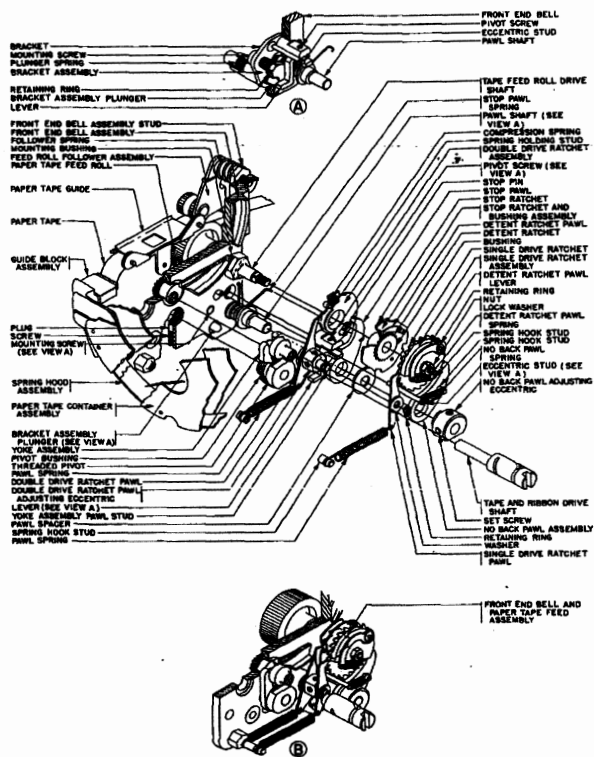


Fig. 25

~~CONFIDENTIAL~~

KAM-1/TSEC

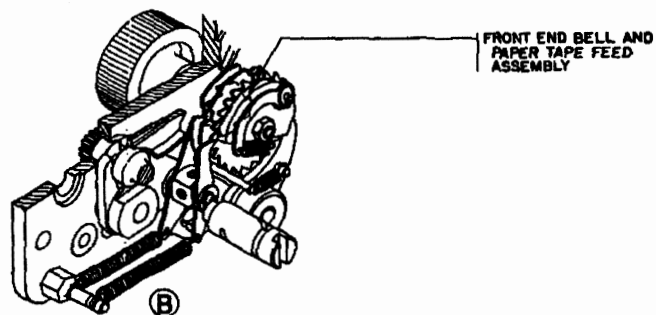
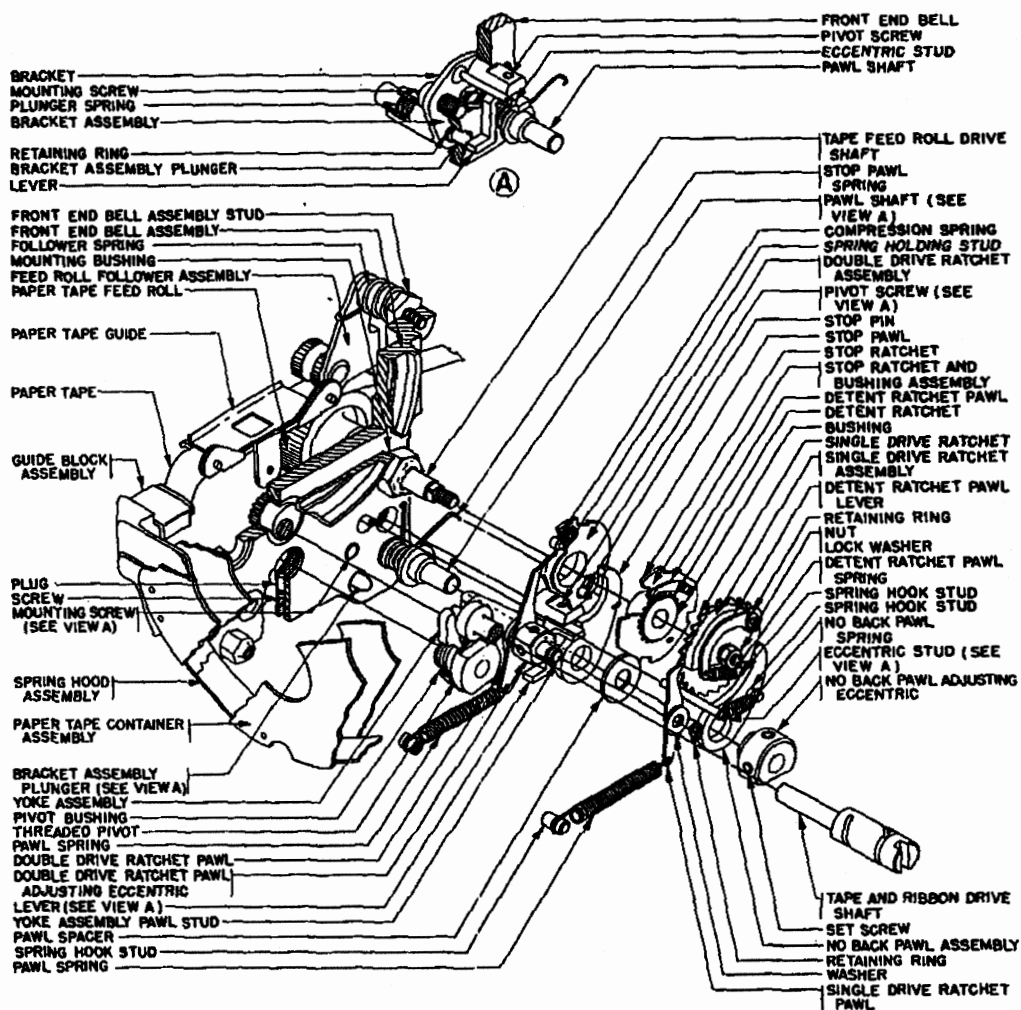
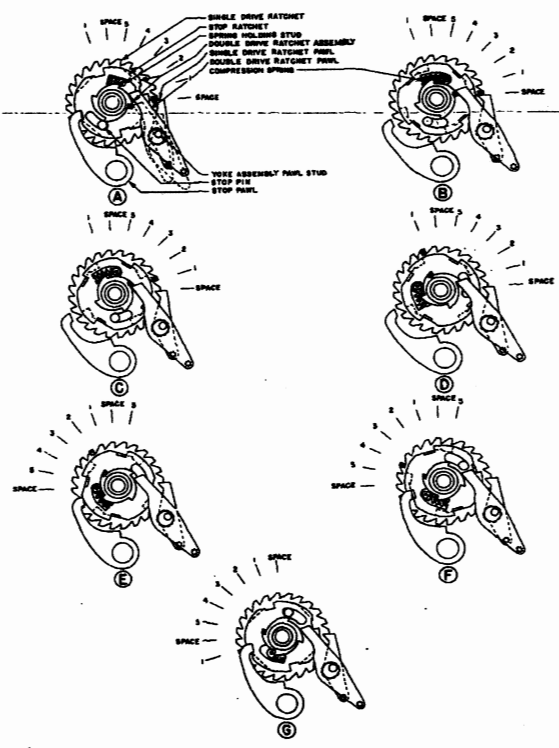


Fig. 25

~~CONFIDENTIAL~~

ORIGINAL



Folded Pages 217 and 218  
 Contain  
 Figure 26

Fig. 26

~~CONFIDENTIAL~~

KAM-1/TSEC

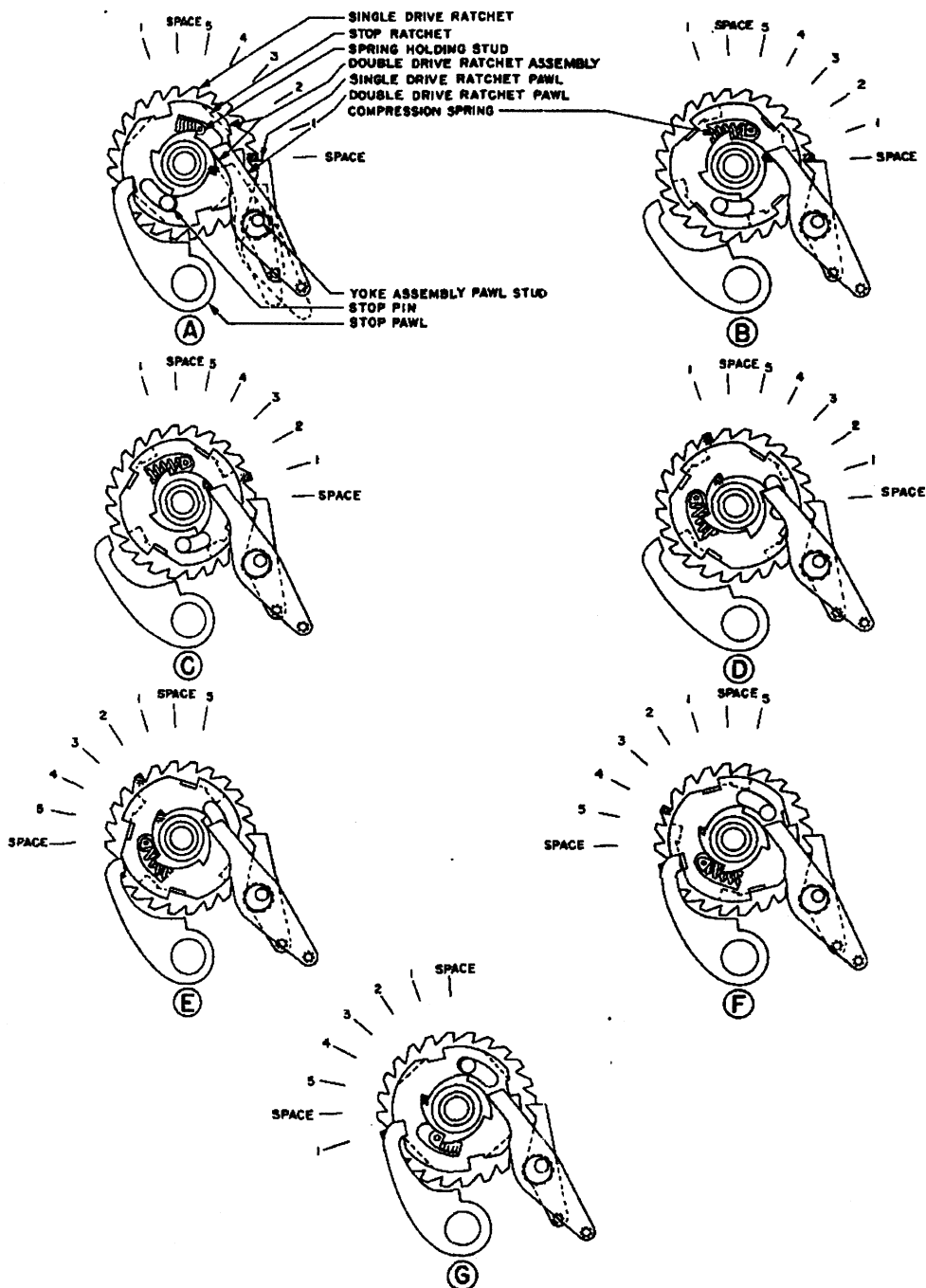
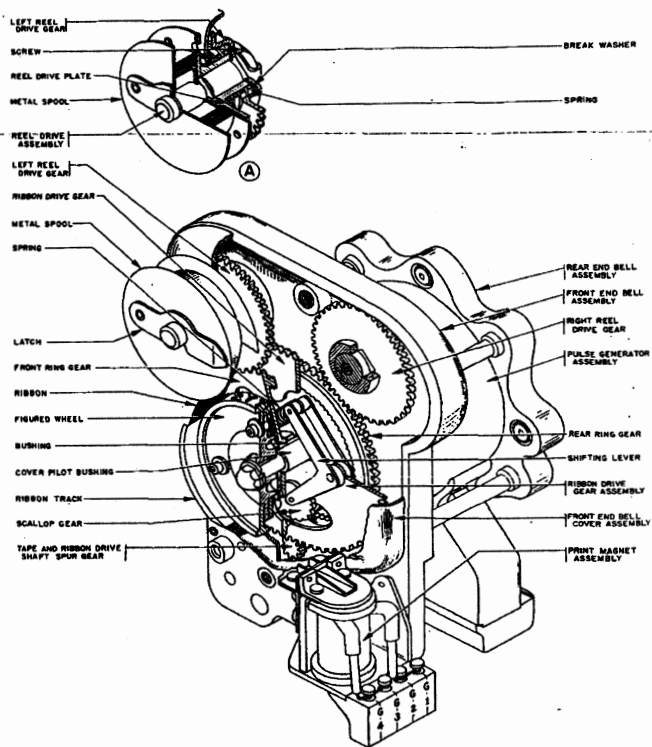


Fig. 26

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~



Folded Pages 219 and 220  
Contain  
Figure 27

Fig. 27

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

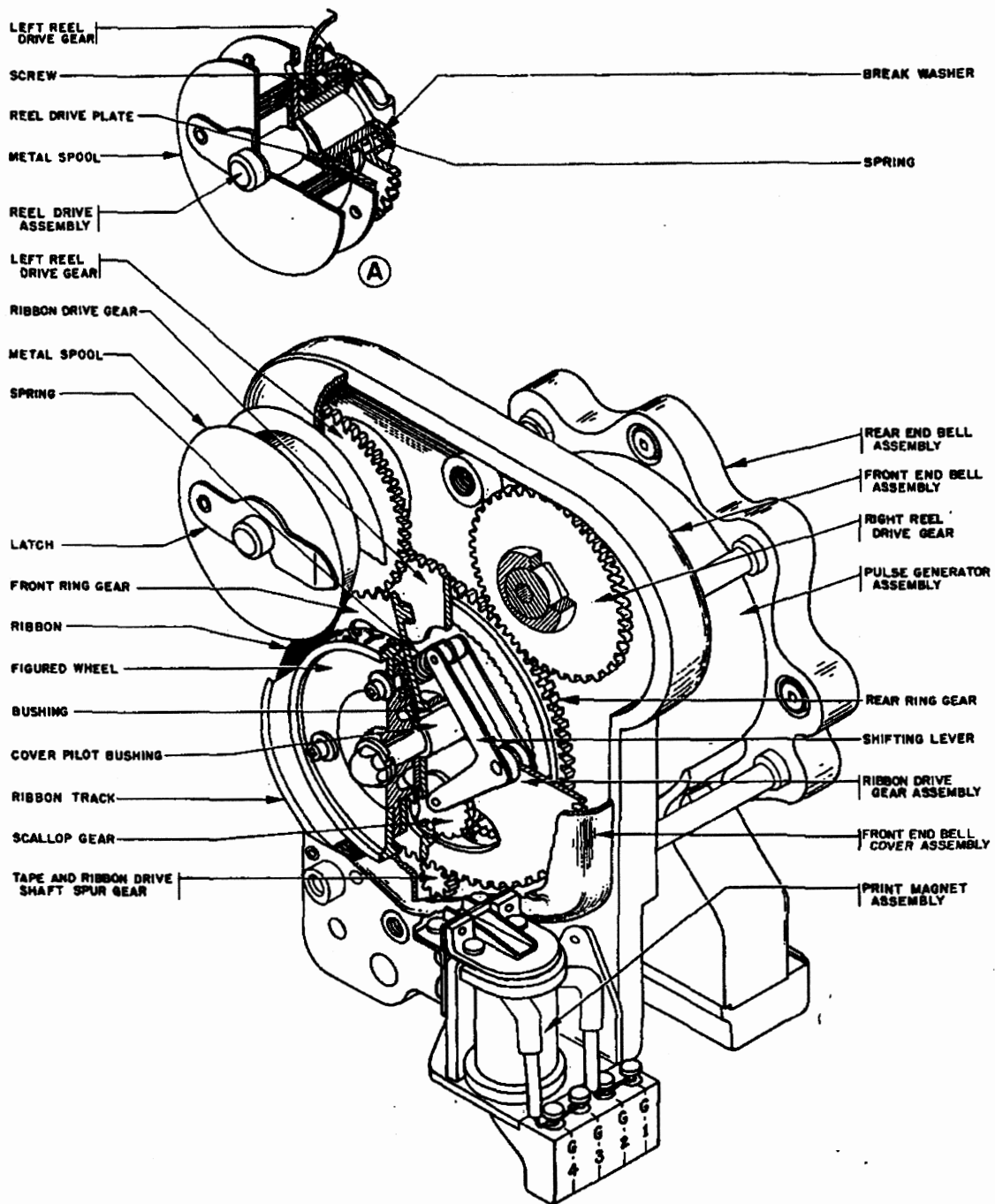


Fig. 27

~~CONFIDENTIAL~~

ORIGINAL

Folded Pages 221 and 222  
Contain  
Figure 28

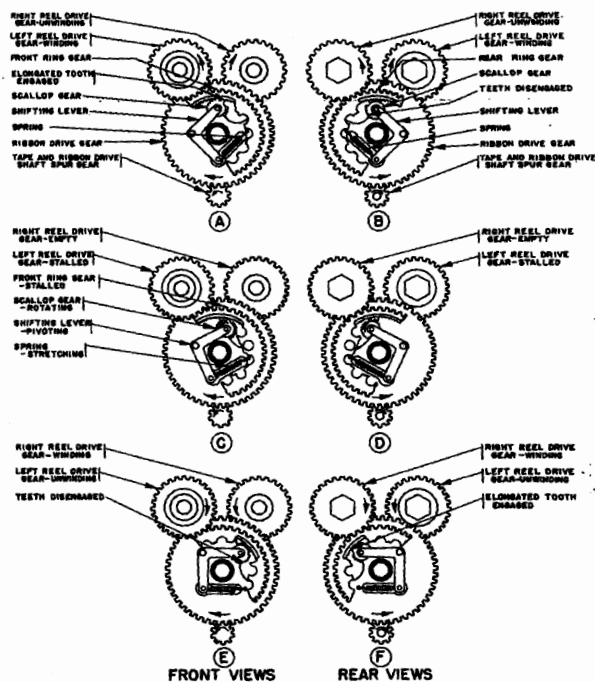


Fig. 28



~~CONFIDENTIAL~~

KAM-1/TSEC

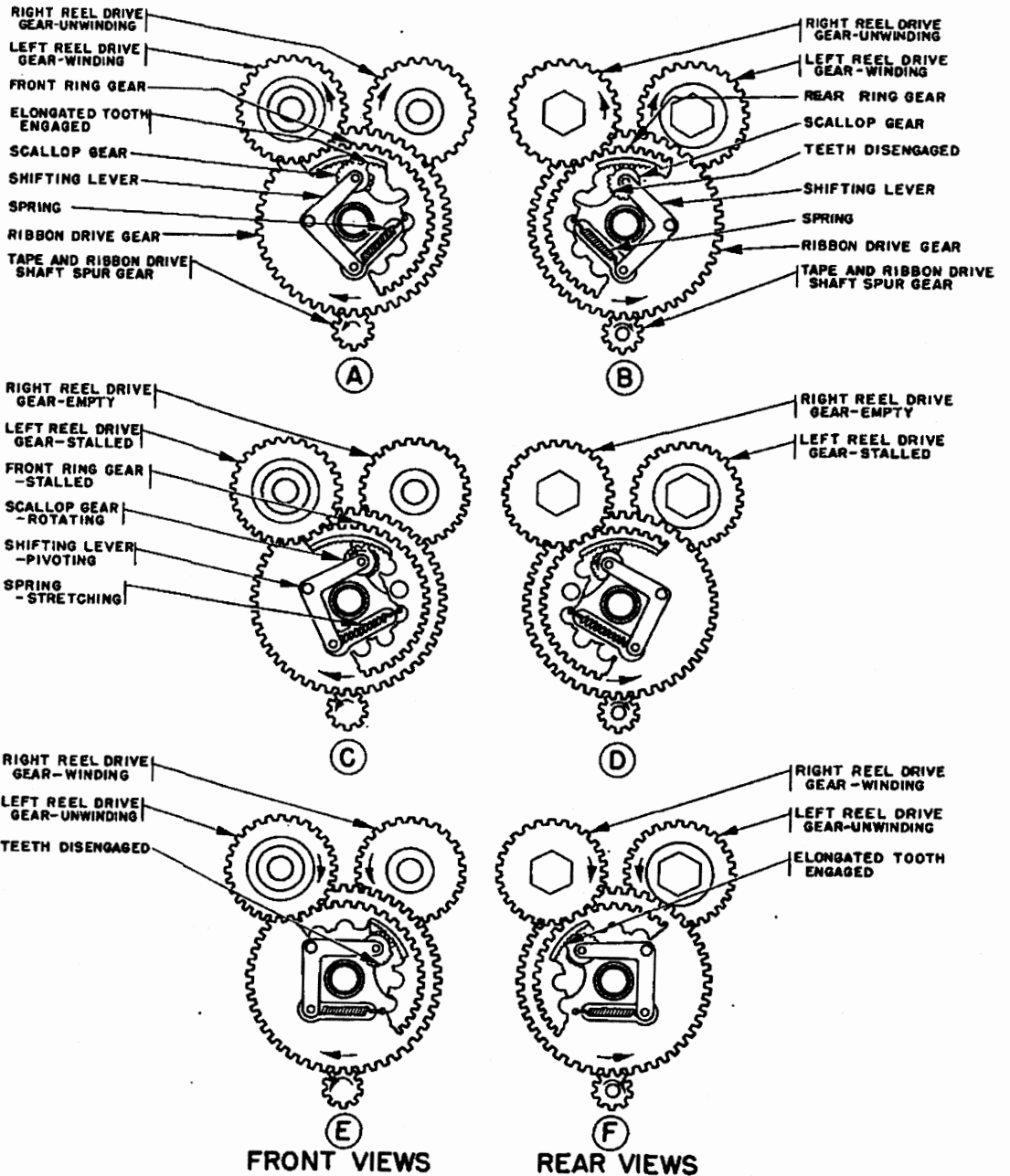


Fig. 28

~~CONFIDENTIAL~~

ORIGINAL

Folded Pages 223 and 224  
Contain  
Figure 29

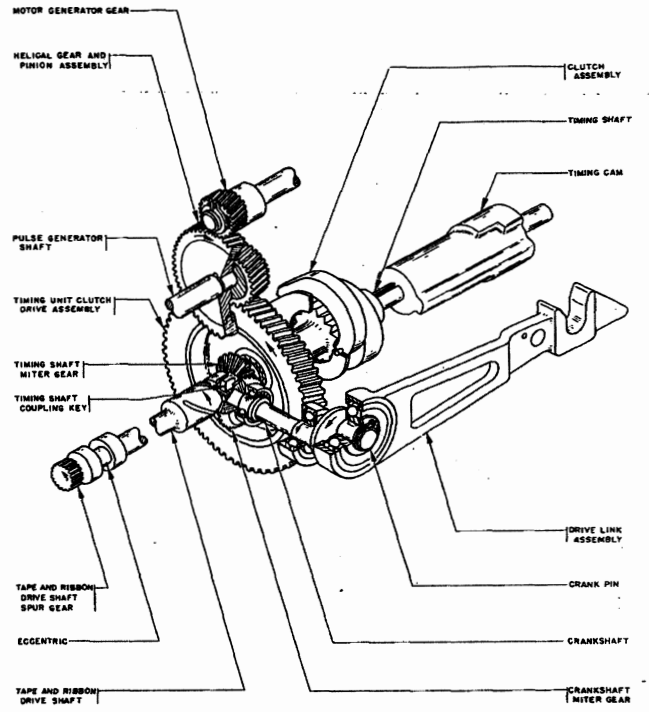


Fig. 29

~~CONFIDENTIAL~~

KAM-1/TSEC

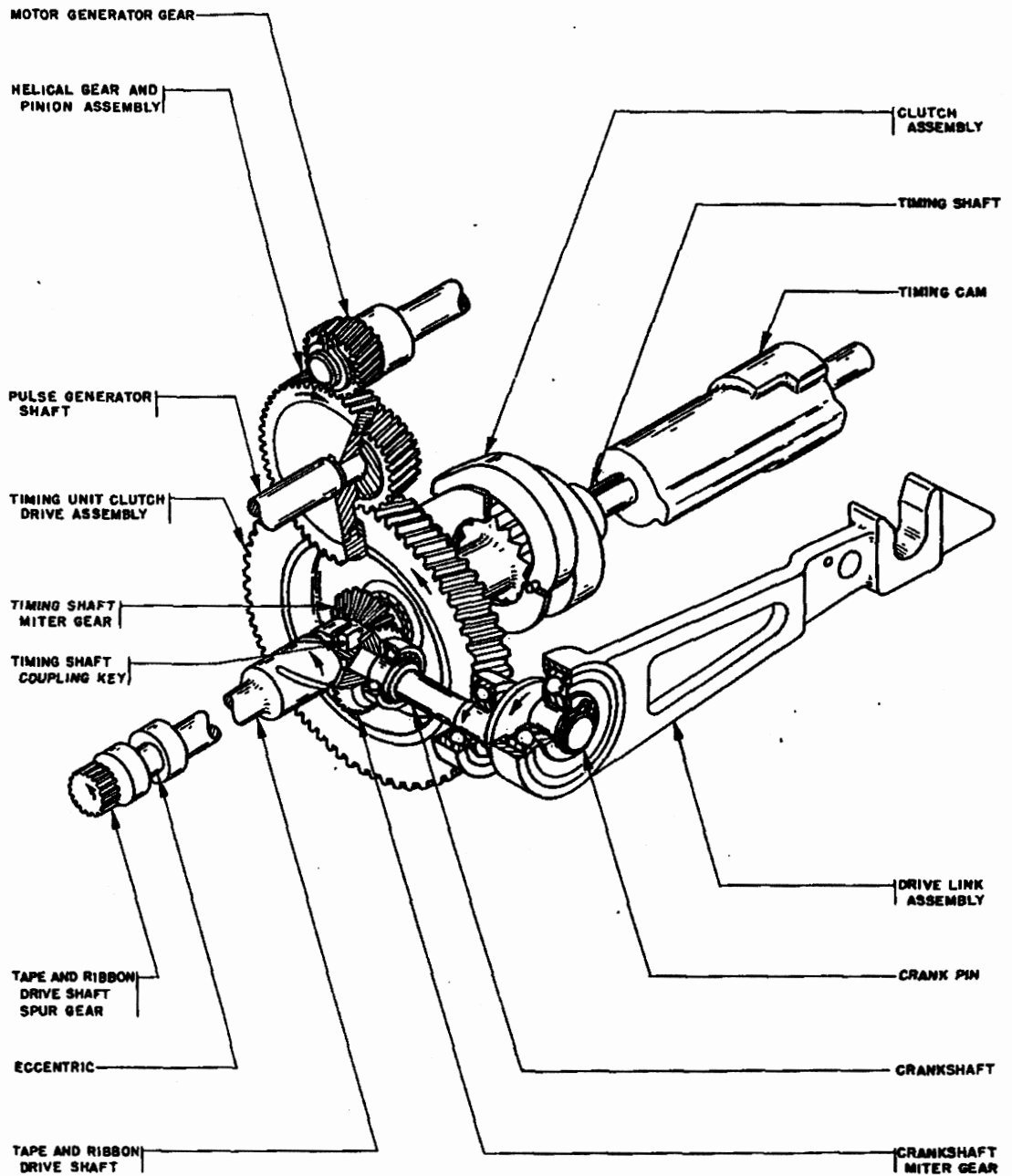
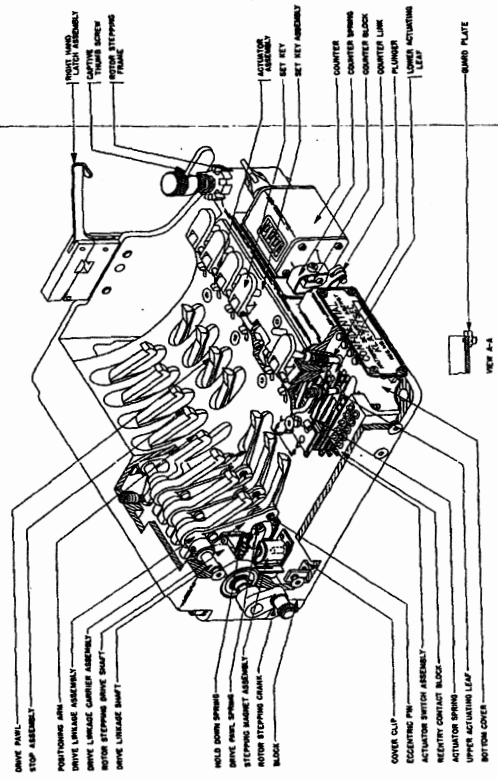


Fig. 29

~~CONFIDENTIAL~~

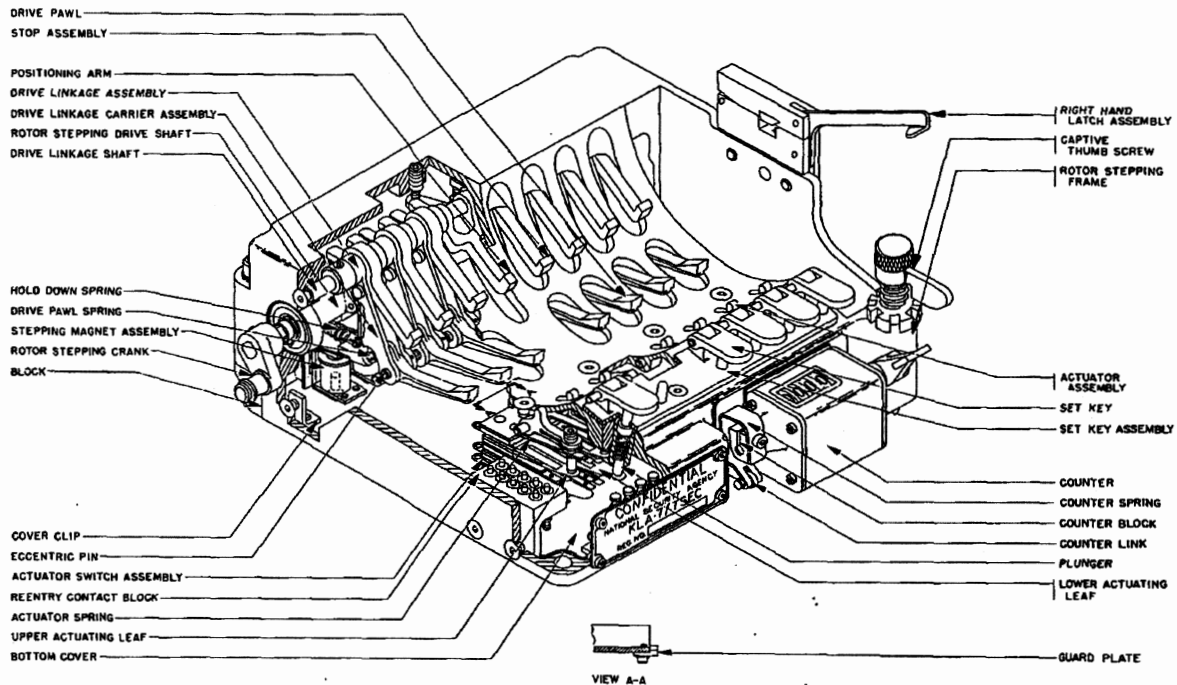
ORIGINAL

Folded Pages 225 and 226  
Contain  
Figure 30



CONFIDENTIAL

CONFIDENTIAL



226

Change No. 3

KAM-1/TSEC

Folded Pages 227 and 228  
Contain  
Figure 31

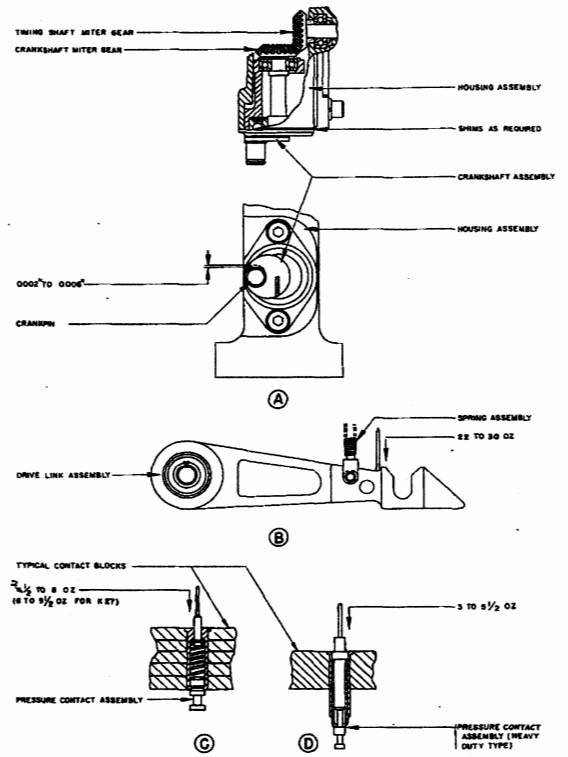


Fig. 31

~~CONFIDENTIAL~~

KAM-1/TSEC

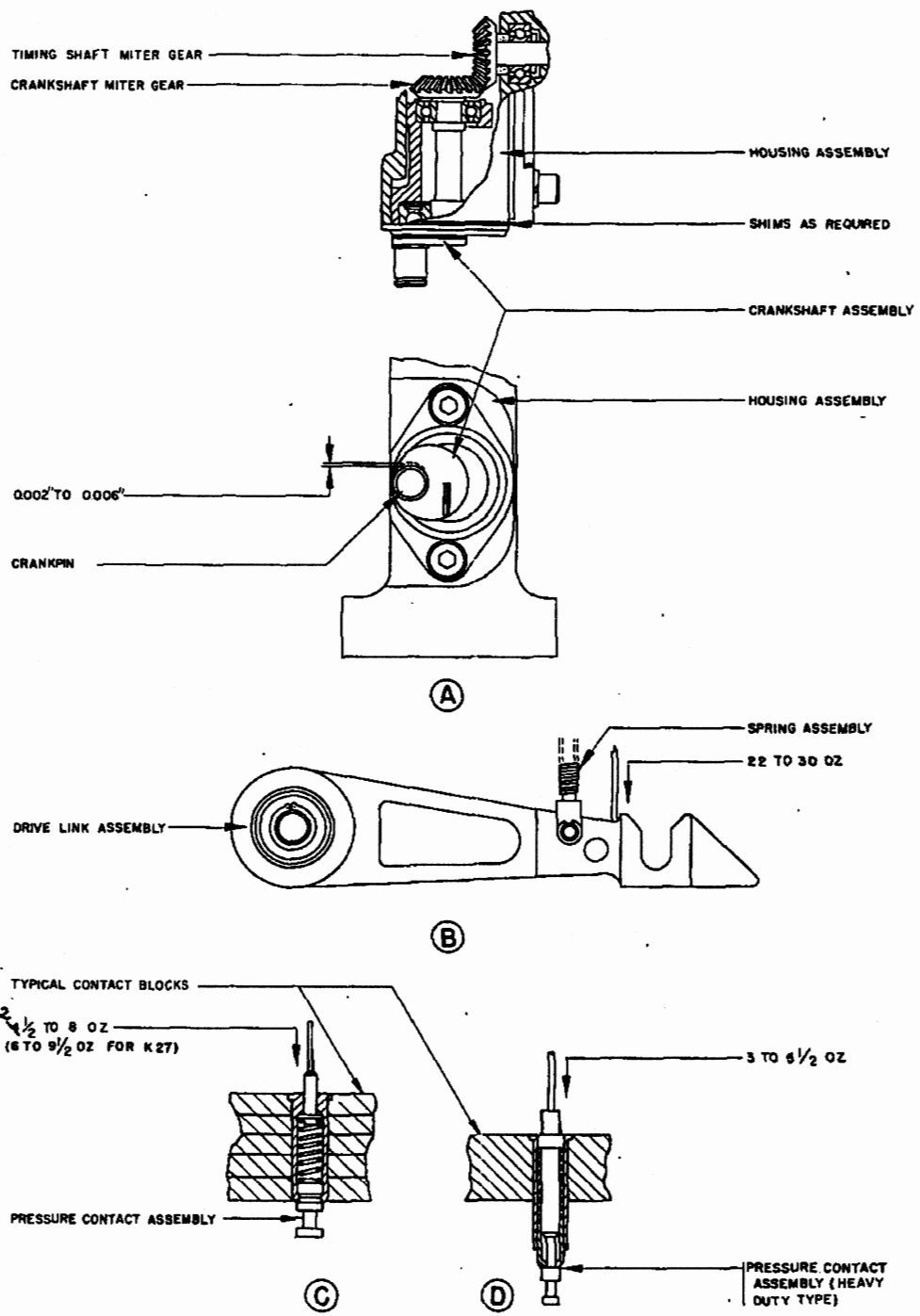
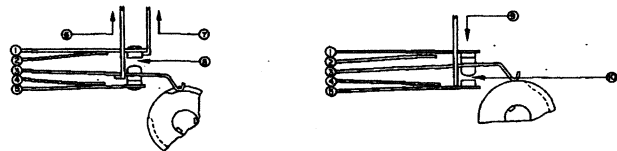


Fig. 31

~~CONFIDENTIAL~~

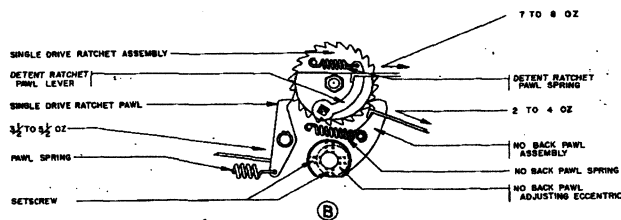
ORIGINAL



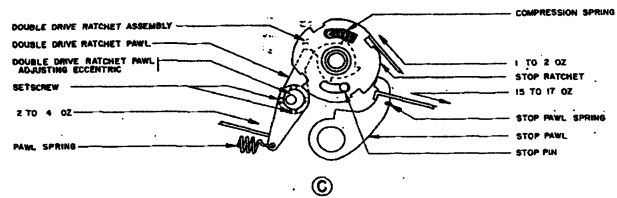
GAP	AMOUNT OF CLEARANCE	BEND STIFFENER	SPRING TENSION	OUNCES	BEND STIFFENER
8	0/16" TO 0/8"	2	6	1 TO 2	2
10	0/16" TO 0/8"	4	7	2 TO 4	4
			8	4 TO 6	6
			9	6 TO 8	8

(A)

Folded Pages 229 and 230  
Contain  
Figure 32



(B)



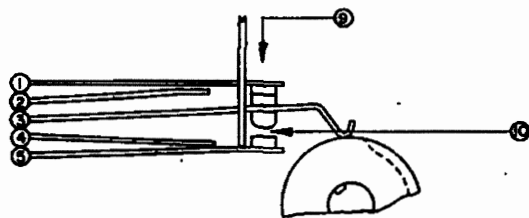
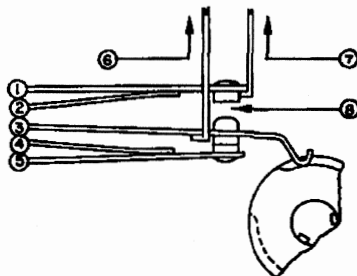
(C)

Fig. 32



~~CONFIDENTIAL~~

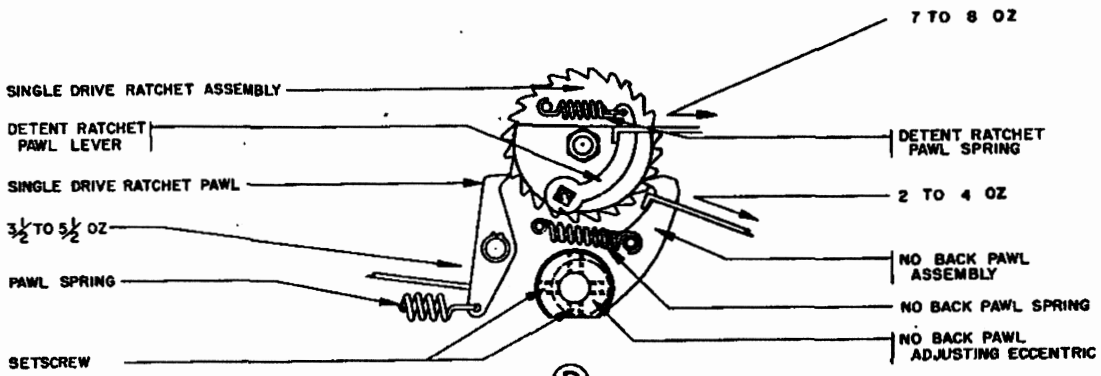
KAM-1/TSEC



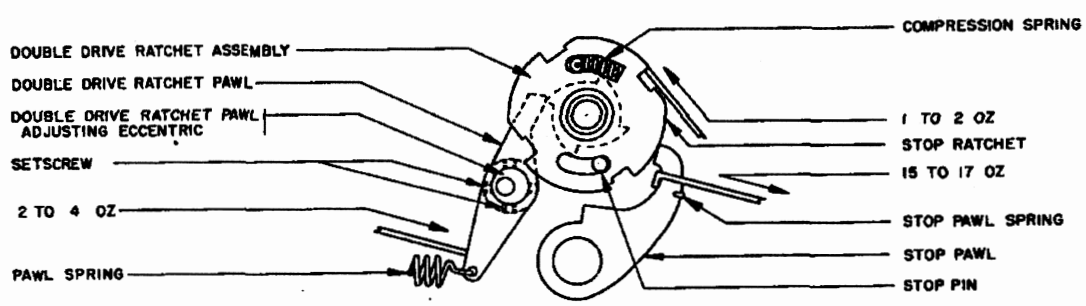
GAP	AMOUNT OF CLEARANCE	BEND STIFFENER
8	.012" TO .015"	2
10	.012" TO .015"	4

SPRING TENSION	OUNCES	BEND STIFFENER
6	2 TO 3	3
7	1 TO 2	1
9	2 TO 3	5

(A)



(B)



(C)

Fig. 32

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

Folded Pages 231 and 232  
Contain  
Figure 33

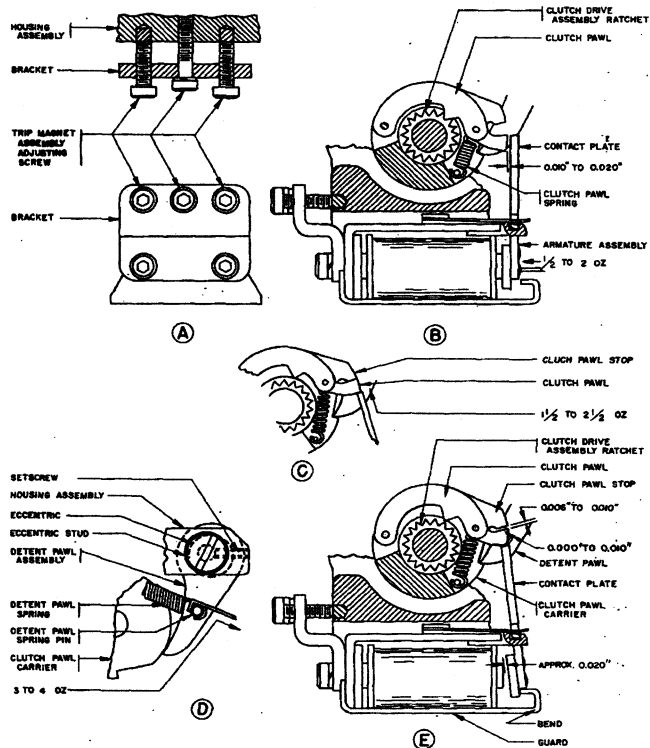


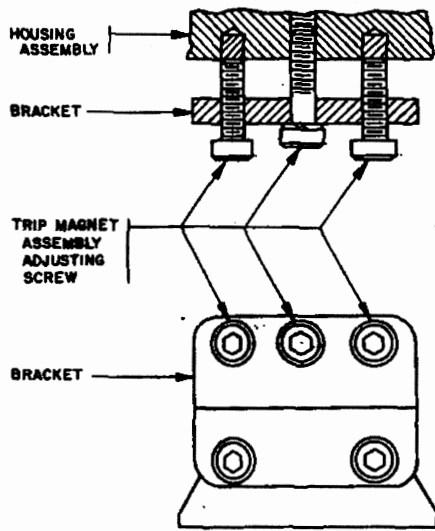
Fig. 33

~~CONFIDENTIAL~~

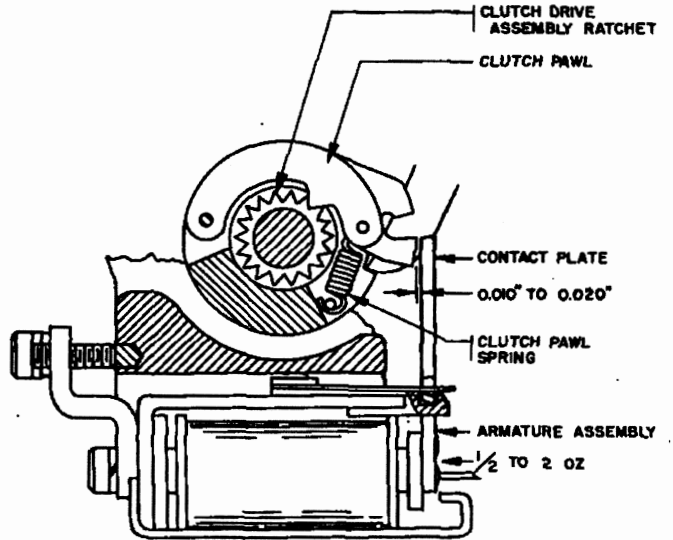
ORIGINAL

~~CONFIDENTIAL~~

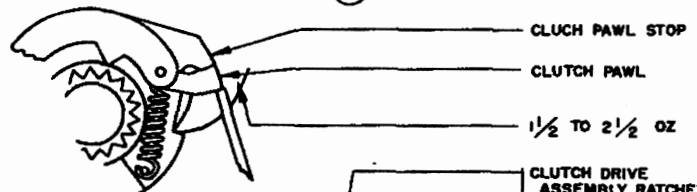
KAM-1/TSEC



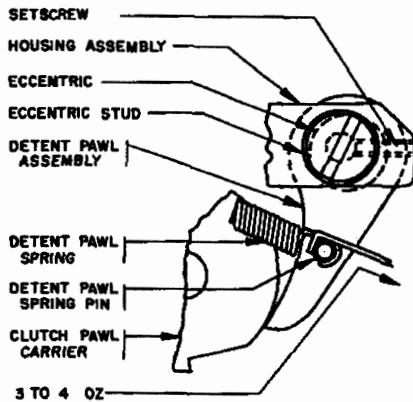
(A)



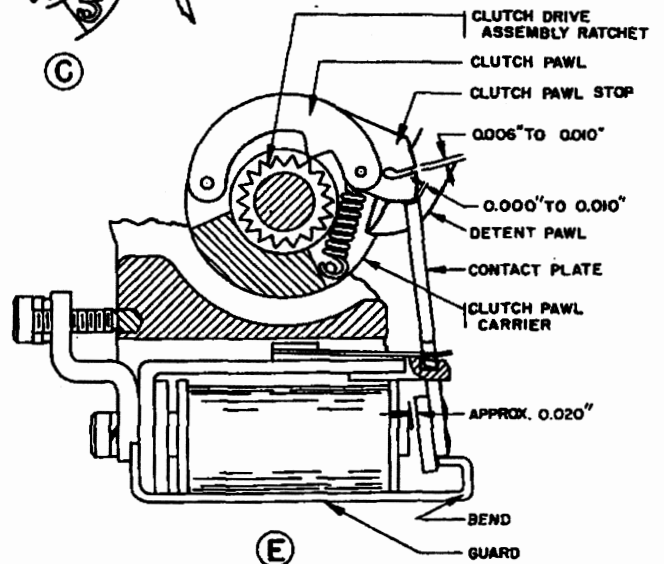
(B)



(C)



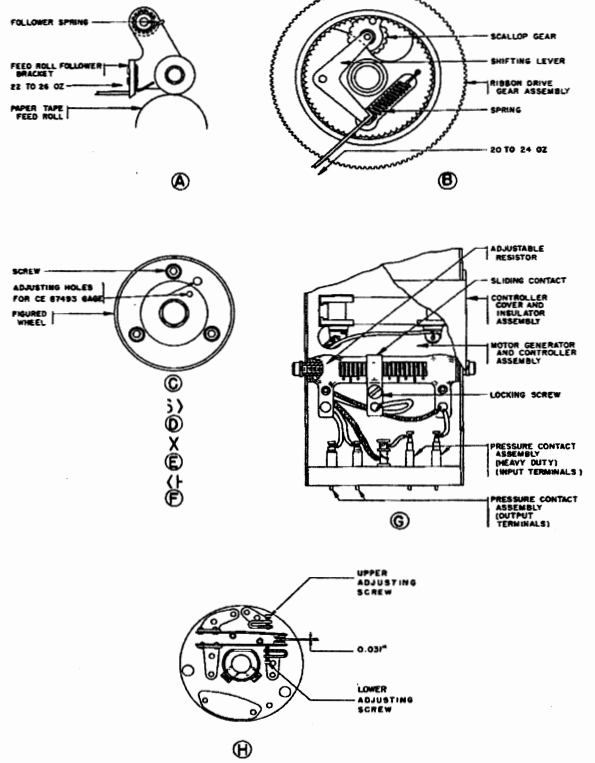
(D)



(E)

Fig. 33

~~CONFIDENTIAL~~

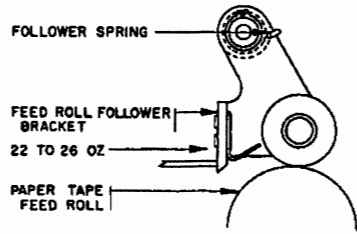


Folded Pages 233 and 234  
Contain  
Figure 34

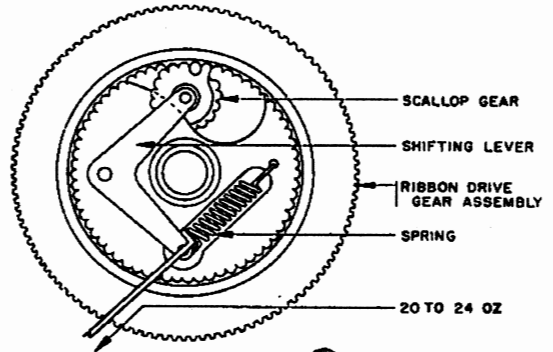
Fig. 34

~~CONFIDENTIAL~~

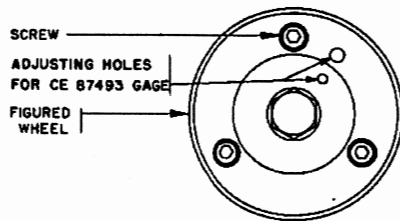
KAM-1/TSEC



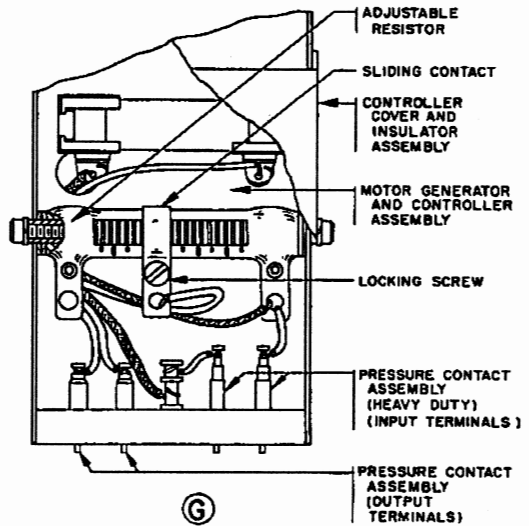
(A)



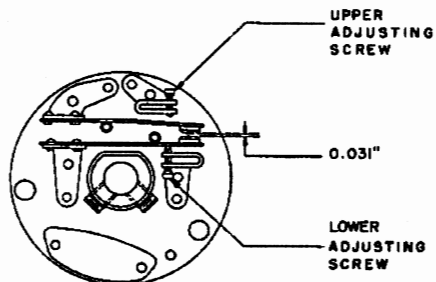
(B)



(C)  
)  
(D)  
(X)  
(E)  
(F)



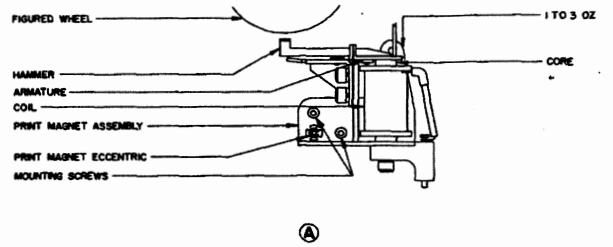
(G)



(H)

Fig. 34

~~CONFIDENTIAL~~



Folded Pages 235 and 236  
 Contain  
 Figure 35

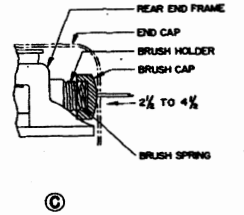
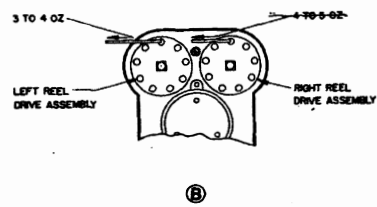
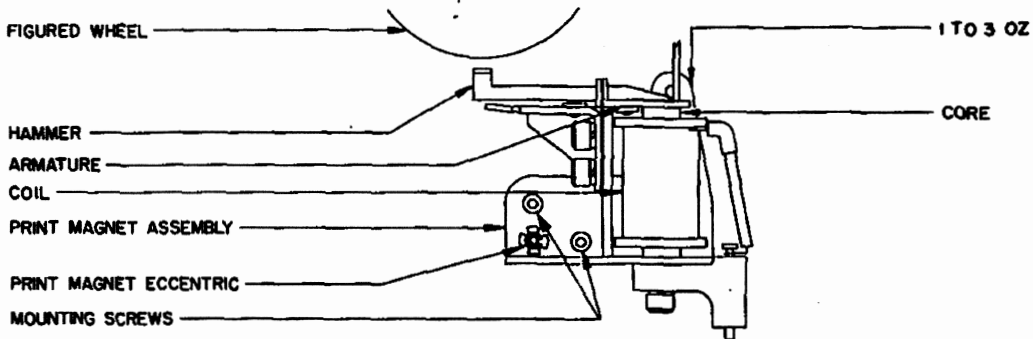


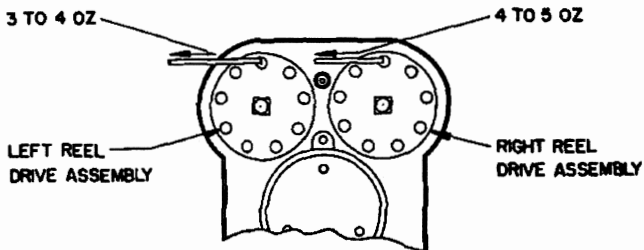
Fig. 35

~~CONFIDENTIAL~~

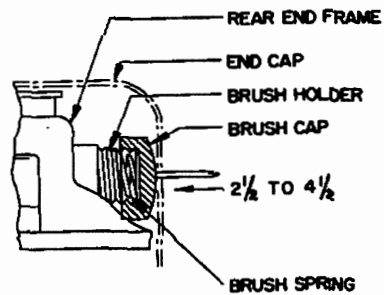
KAM-1/TSEC



(A)



(B)



(C)

Fig. 35

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Folded Pages 237 and 238  
Contain  
Figure 36

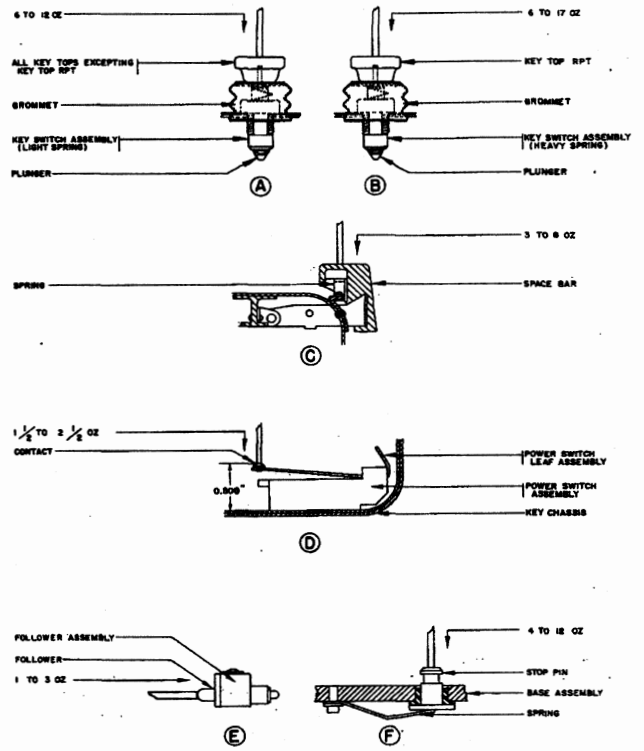


Fig. 36

~~CONFIDENTIAL~~

ORIGINAL



~~CONFIDENTIAL~~

KAM-1/TSEC

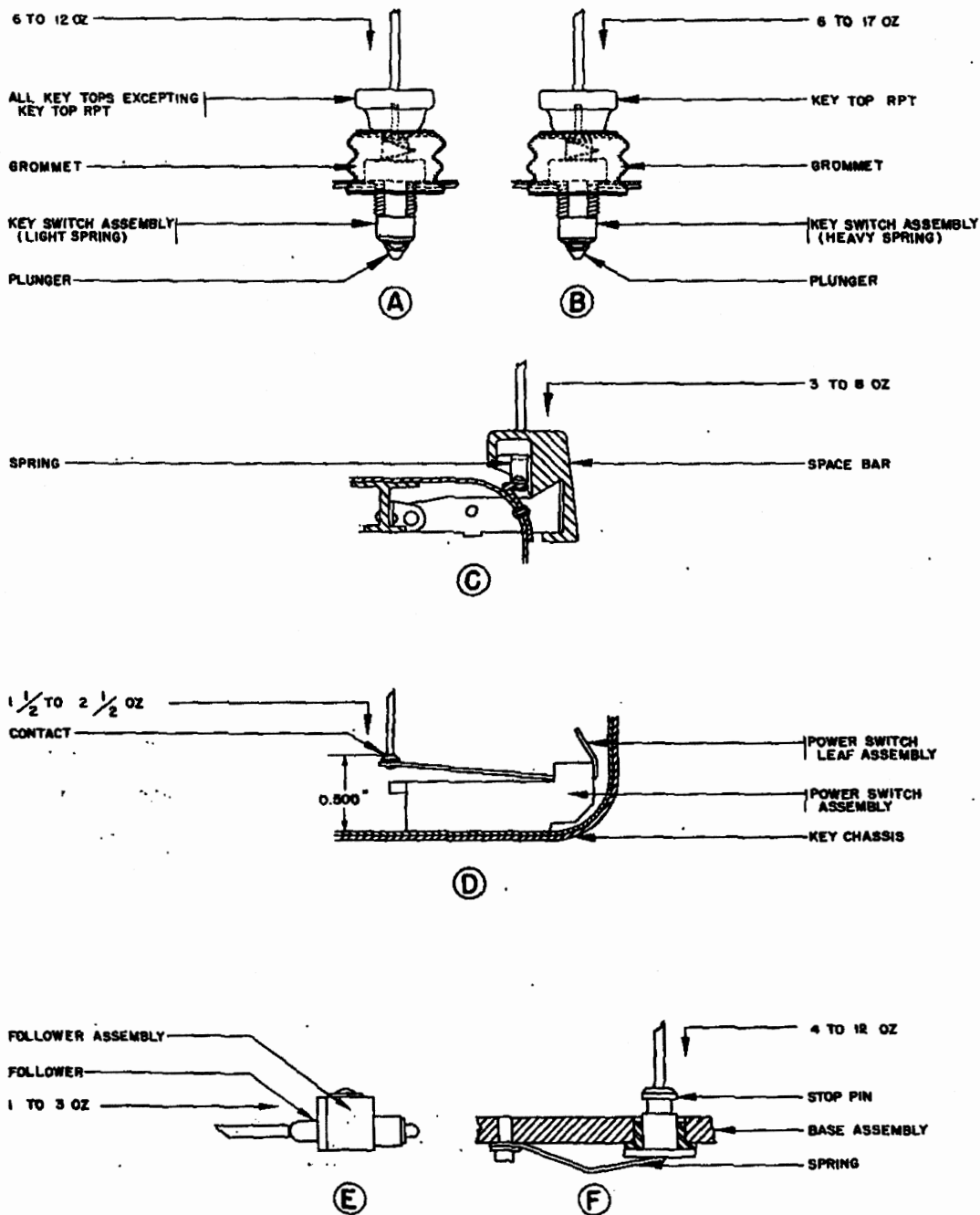
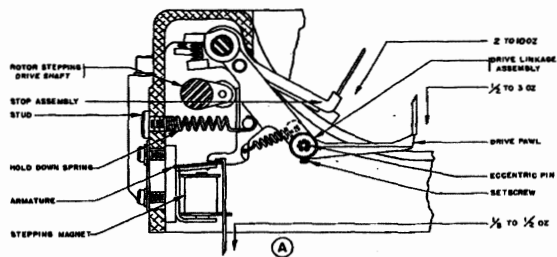


Fig. 36

~~CONFIDENTIAL~~



Folded Pages 239 and 240  
Contain  
Figure 37

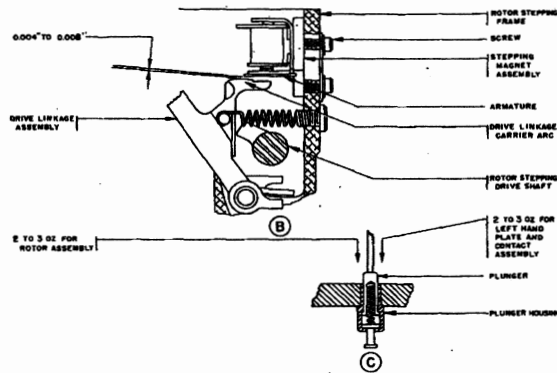


Fig. 37

~~CONFIDENTIAL~~

KAM-1/TSEC

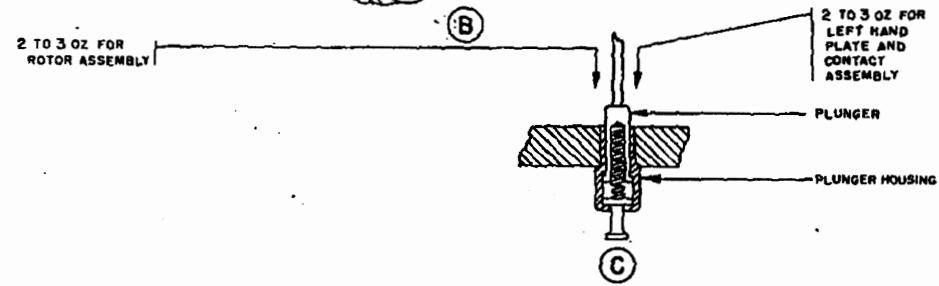
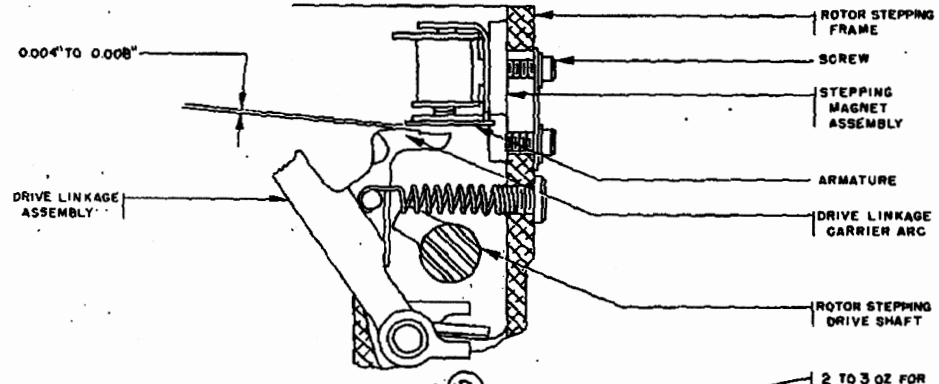
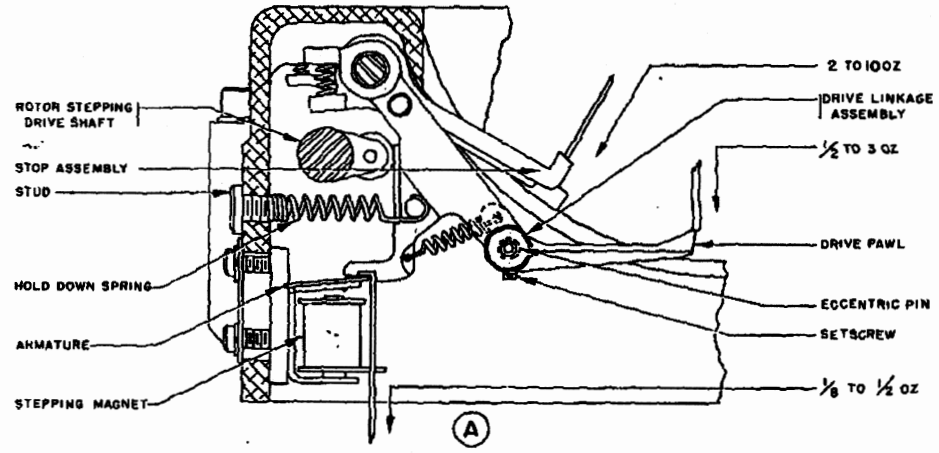
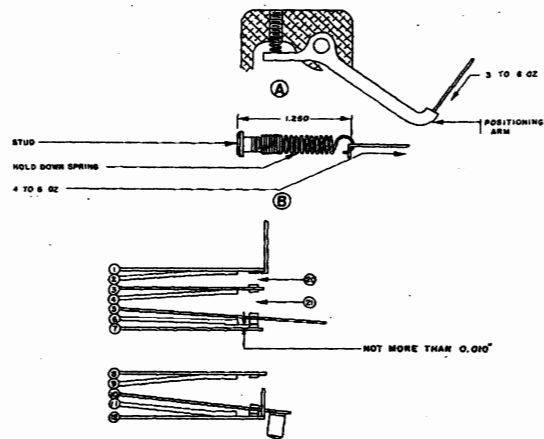


Fig. 37

~~CONFIDENTIAL~~

CONFIDENTIAL

KAM-1/TSEC



Folded Pages 241 and 242  
Contain  
Figure 38

GAP	AMOUNT OF CLEARANCE	BEND STIFFENER
20	.012 TO .015	2
21	.018 TO .020	4

GAMING SURFACE	TOLERANCE	ADJUSTMENT
1	0.002 TO 0.005	POSITION ADJUSTING SCREW (7)
2	(10) SHOULD JUST MATE WITH (12)	BEND STIFFENER (10)
3	(10) SHOULD JUST MATE WITH (8)	BEND STIFFENER (9)

\*SEE TEXT, SUBPAR. 6.003

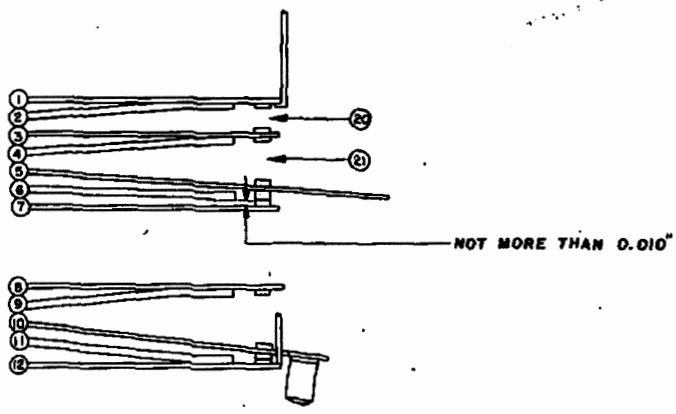
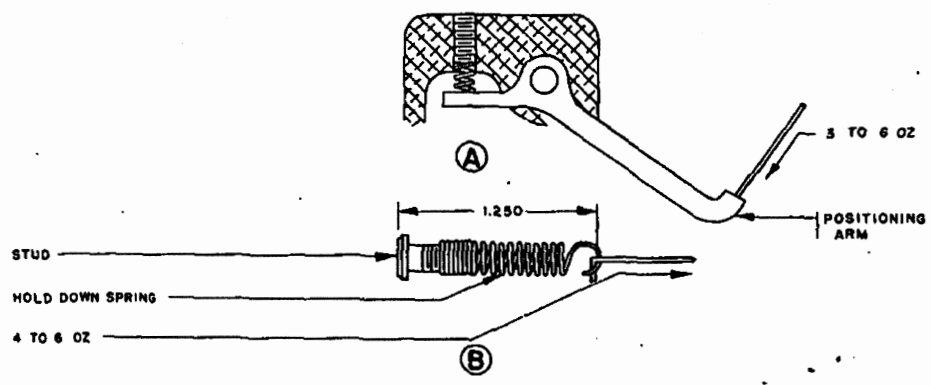
©

Fig. 38

CONFIDENTIAL

~~CONFIDENTIAL~~

KAM-1/TSEC



GAP	AMOUNT OF CLEARANCE	BEND STIFFENER
20	.012" TO .015"	2
21	.015" TO .020"	4

CAMMING SURFACE	TOLERANCE	ADJUSTMENT
1	0.025" TO 0.035"	POSITION ADJUSTING SCREW
2	(10) SHOULD JUST MATE WITH (12)	BEND STIFFENER (11)
3	(10) SHOULD JUST MATE WITH (8)	BEND STIFFENER (9)

\*SEE TEXT, SUBPAR. 6208 d

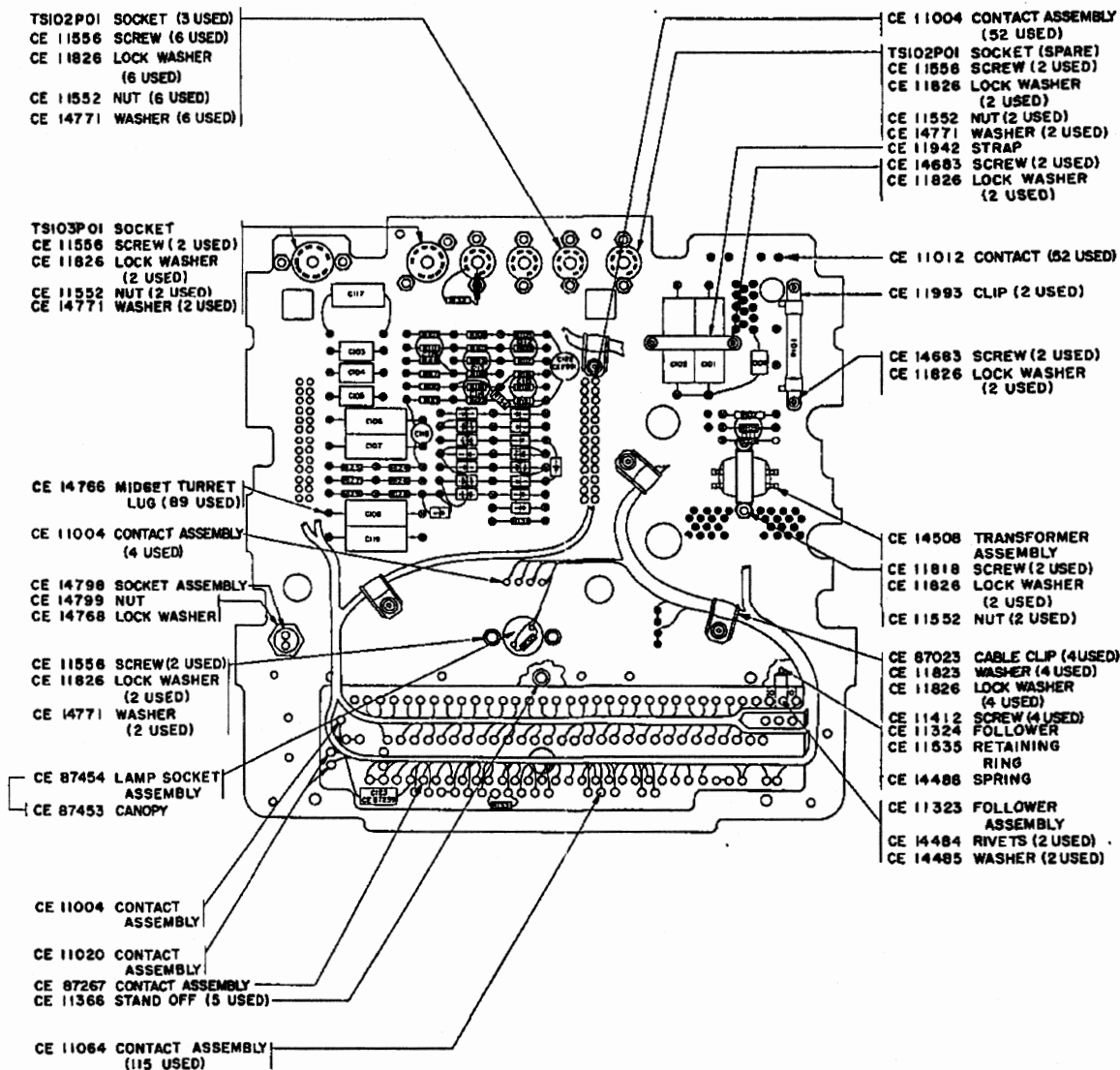
(C)

Fig. 38

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



**LEGEND**

- - PRESSURE CONTACT
- - FLATHEAD CONTACT
- ⊙ - MIDGET TURRET LUG

**CE 11941 CONTACT PANEL ASSEMBLY**

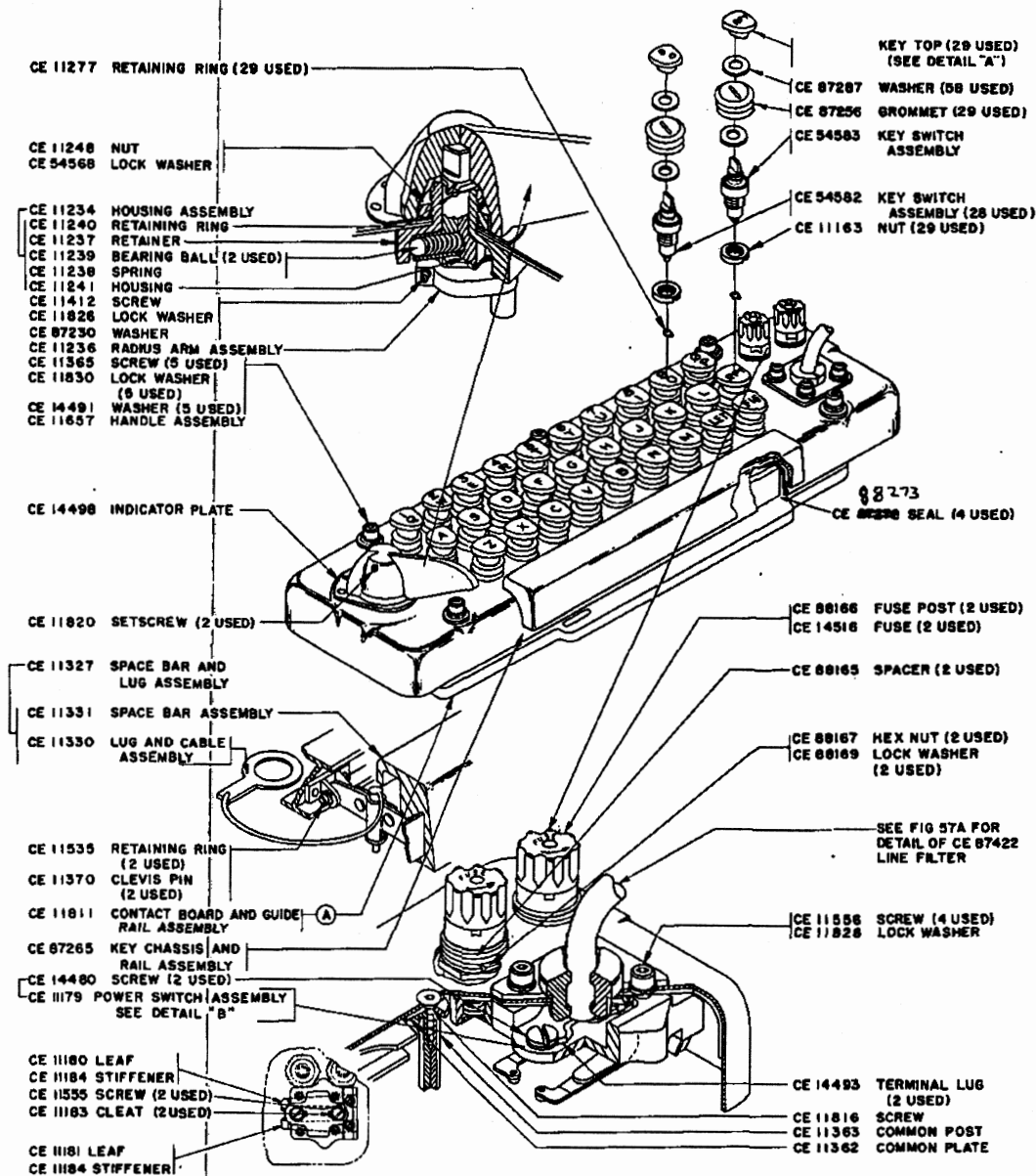
PART NUMBERS FOR ELECTRICAL COMPONENTS LISTED IN CHARTS IN SECTION 3500

Fig. 39

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



DETAIL "B"

DETAIL "A"

CE 11167 KEY TOP A	CE 11487 KEY TOP G	CE 11493 KEY TOP M	CE 11498 KEY TOP S	CE 11512 KEY TOP Y-6
CE 11168 KEY TOP B	CE 11488 KEY TOP H	CE 11494 KEY TOP N	CE 11511 KEY TOP T-5	CE 11506 KEY TOP Z
CE 11271 KEY TOP C	CE 11514 KEY TOP I - 8	CE 11515 KEY TOP O-9	CE 11513 KEY TOP U-7	CE 11171 KEY TOP FIG
CE 11356 KEY TOP D	CE 11490 KEY TOP J	CE 11516 KEY TOP P-8	CE 11502 KEY TOP V	CE 11170 KEY TOP LET
CE 11509 KEY TOP E-3	CE 11491 KEY TOP K	CE 11507 KEY TOP Q-1	CE 11508 KEY TOP W-2	CE 11172 KEY TOP RPT
CE 11486 KEY TOP F	CE 11492 KEY TOP L	CE 11510 KEY TOP R-4	CE 11504 KEY TOP X	

KEY TOPS

CE 11371 KEYBOARD ASSEMBLY  
(EXCLUDES PART MARKED (A))

Fig. 40

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

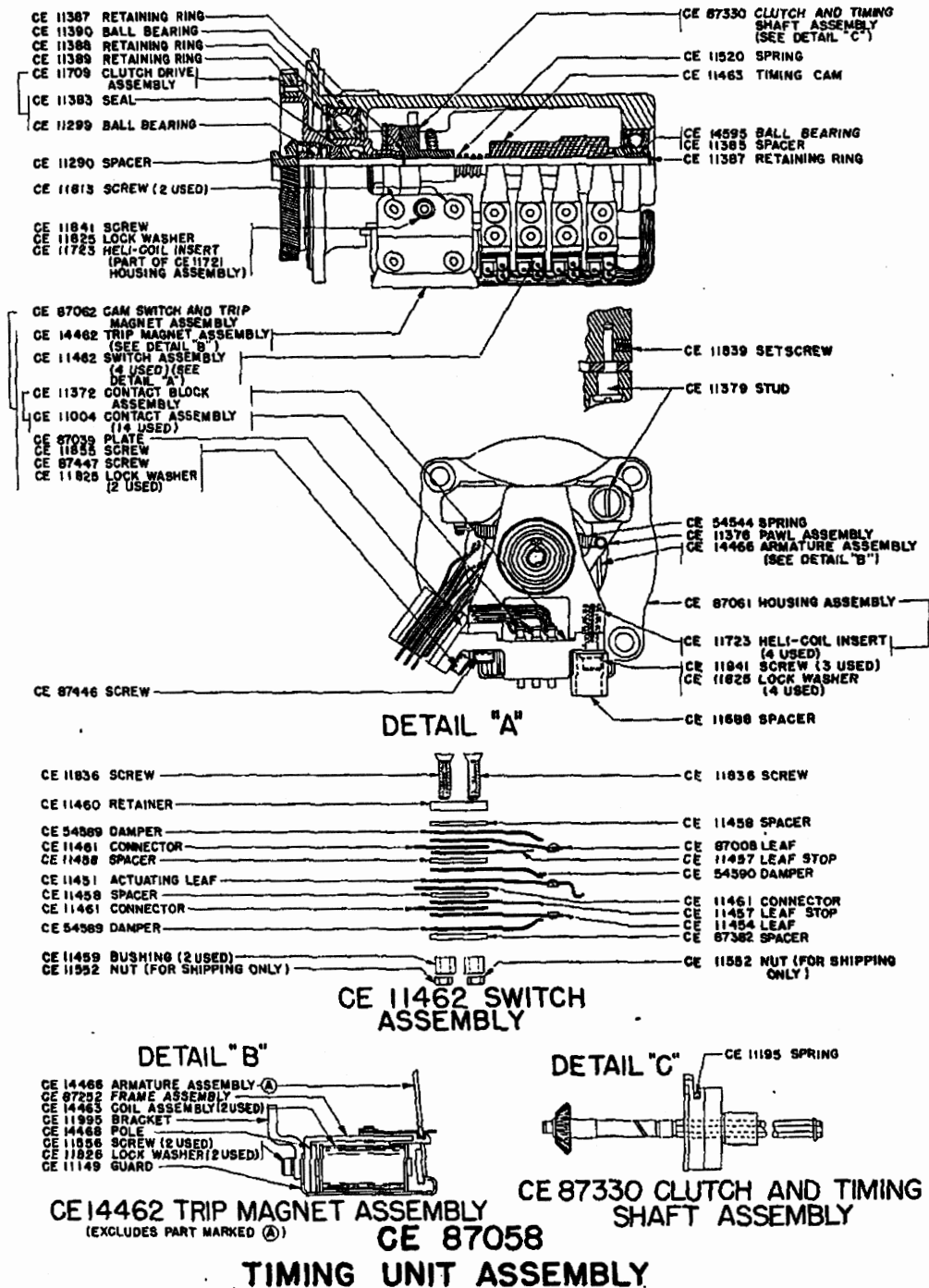


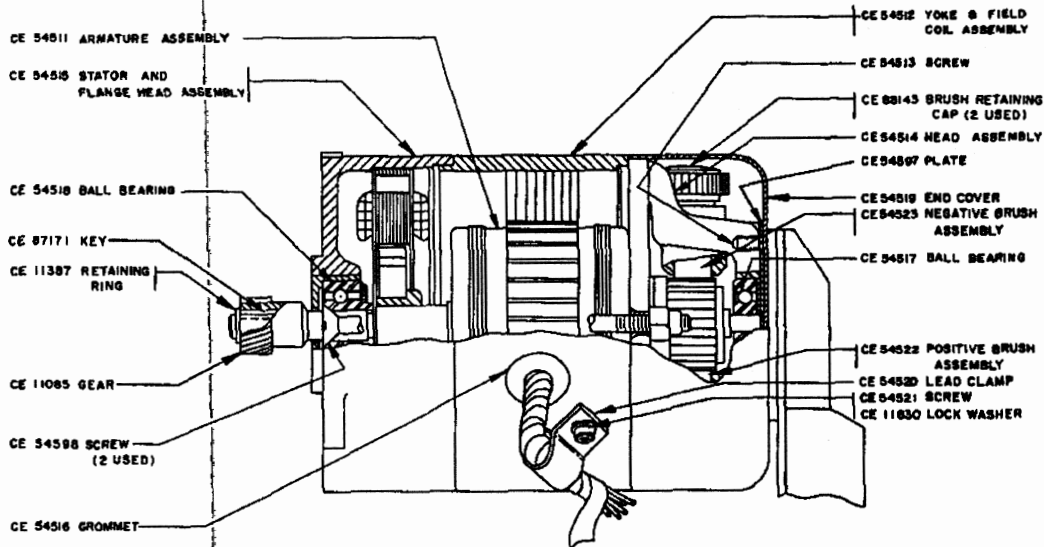
Fig. 41

~~CONFIDENTIAL~~

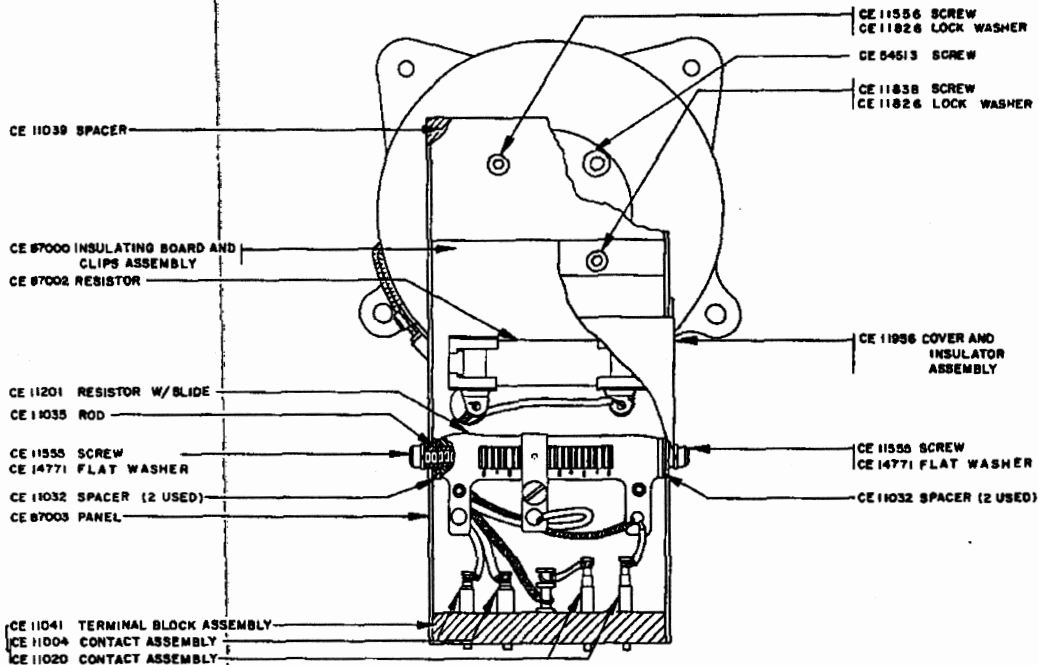


~~CONFIDENTIAL~~

KAM-1/TSEC



**CE 87419 MOTOR GENERATOR ASSEMBLY**



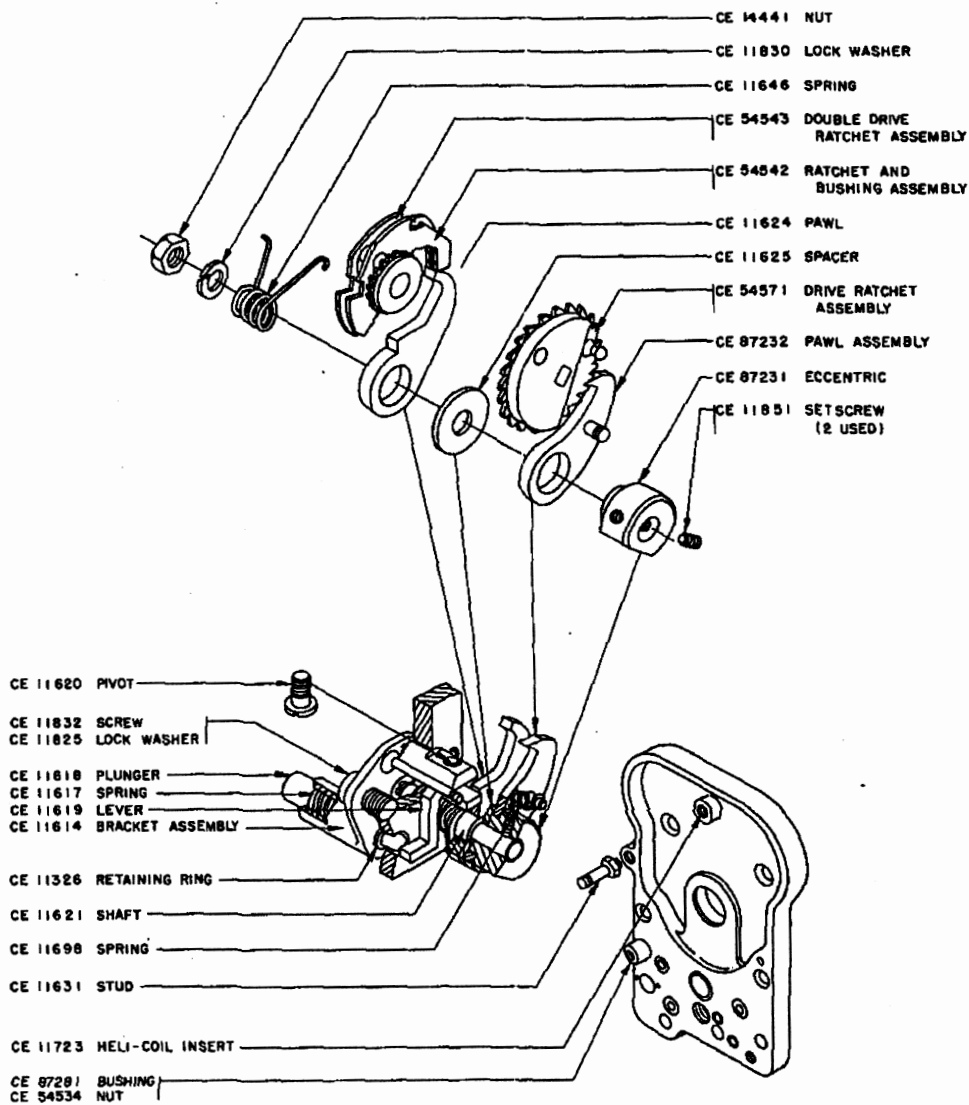
**CE 87420 MOTOR GENERATOR AND CONTROLLER ASSEMBLY**

Fig. 42

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



See also Figures 44 and 45 for associated parts

Fig. 43

~~CONFIDENTIAL~~

ORIGINAL

KAM-1/TSEC

ORIGINAL

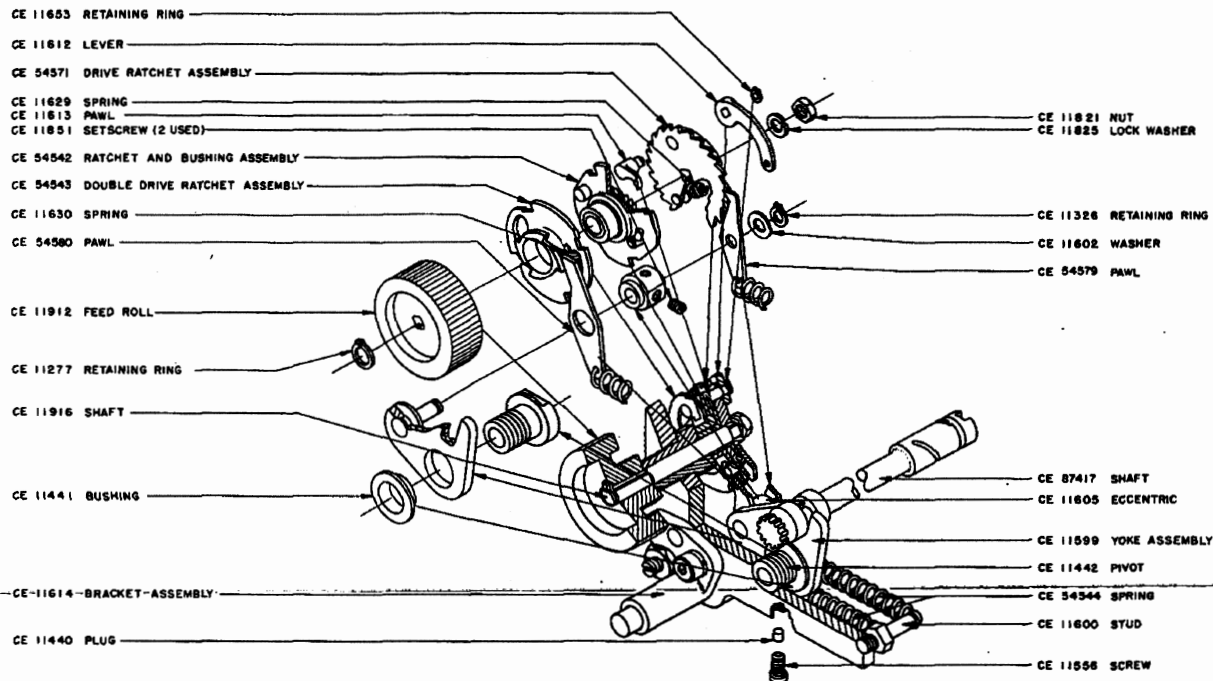


Fig. 44

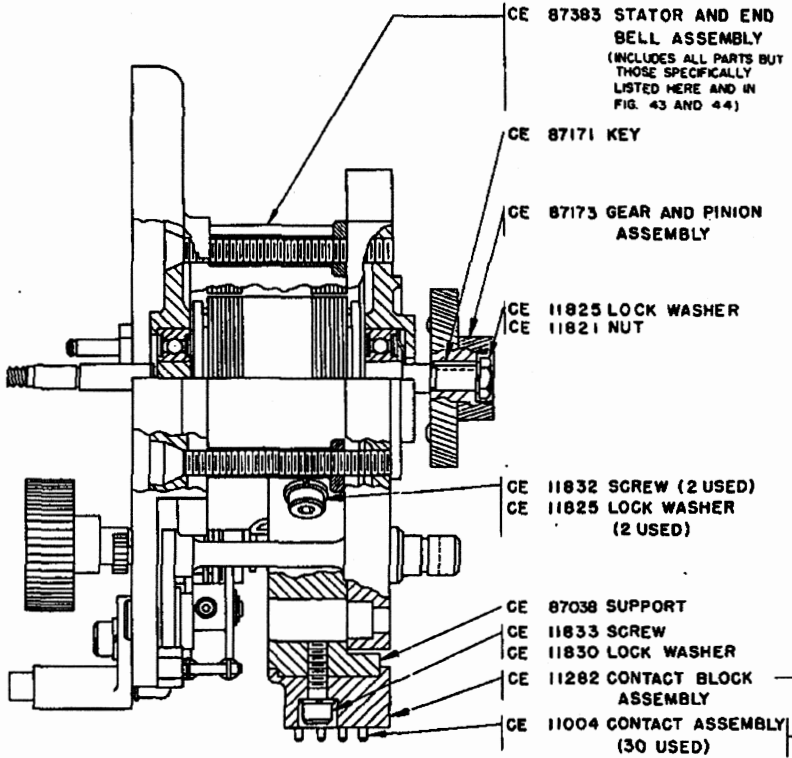
248

See also Figures 43 and 45 for associated parts

CONFIDENTIAL

CONFIDENTIAL

~~CONFIDENTIAL~~



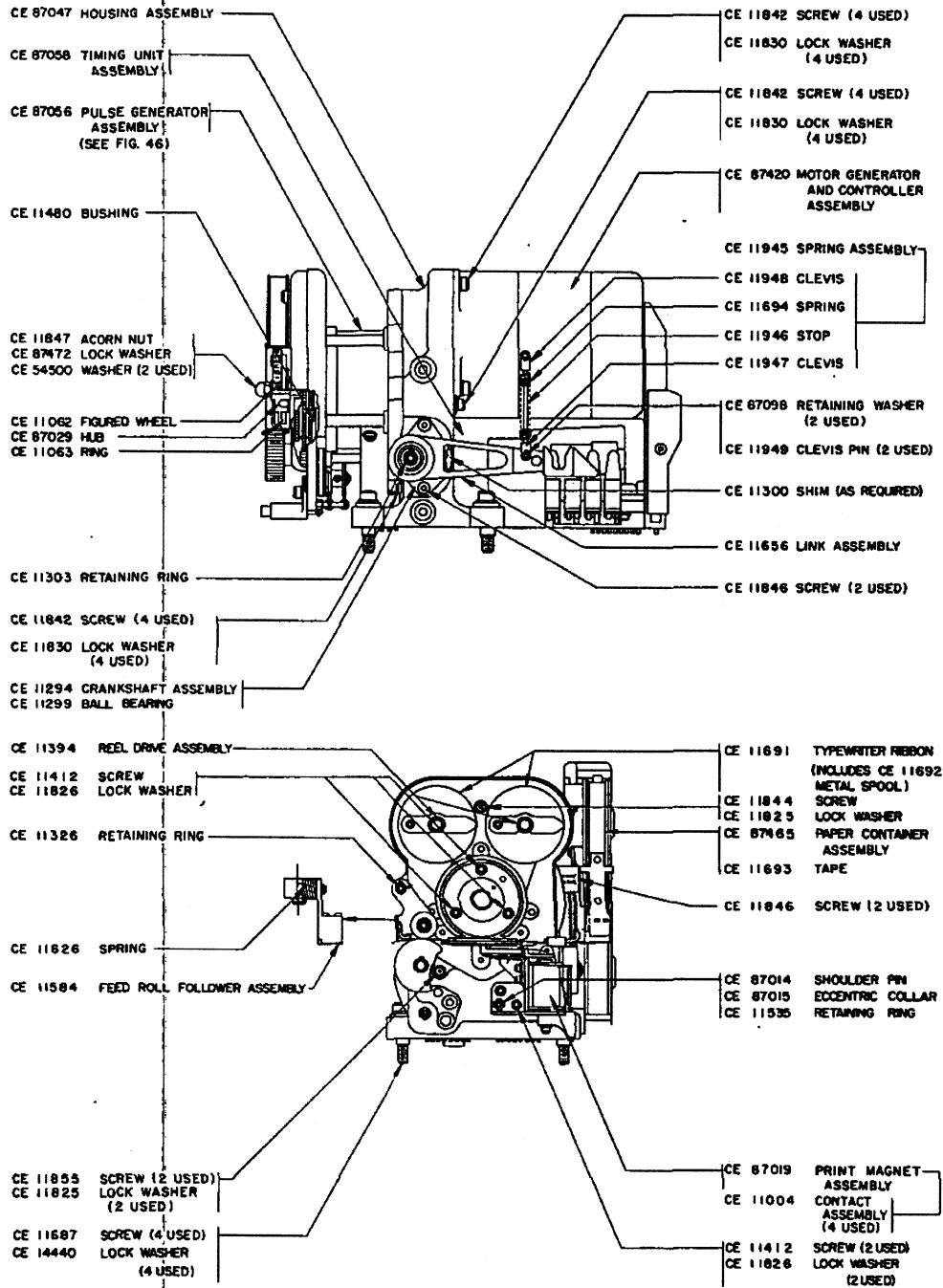
# CE 87056 PULSE GENERATOR ASSEMBLY

Fig. 45

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



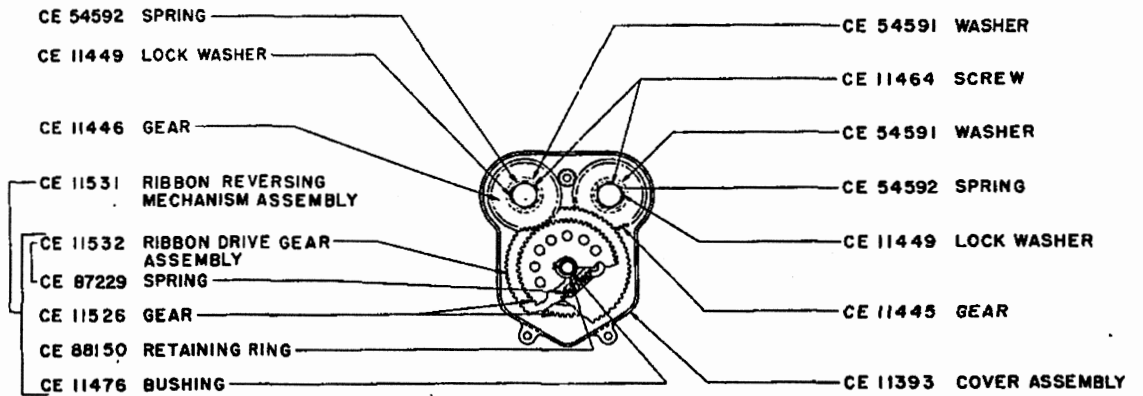
**CE 87059 PRINTER ASSEMBLY**  
**(Includes Parts Shown Above Plus All Parts In Figure 47)**

Fig. 46

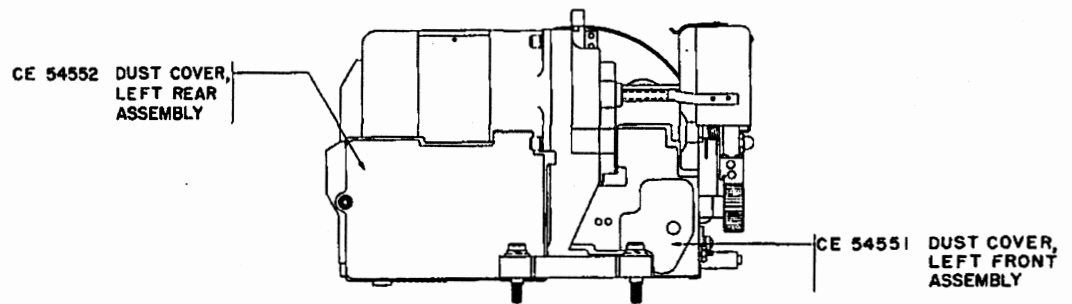
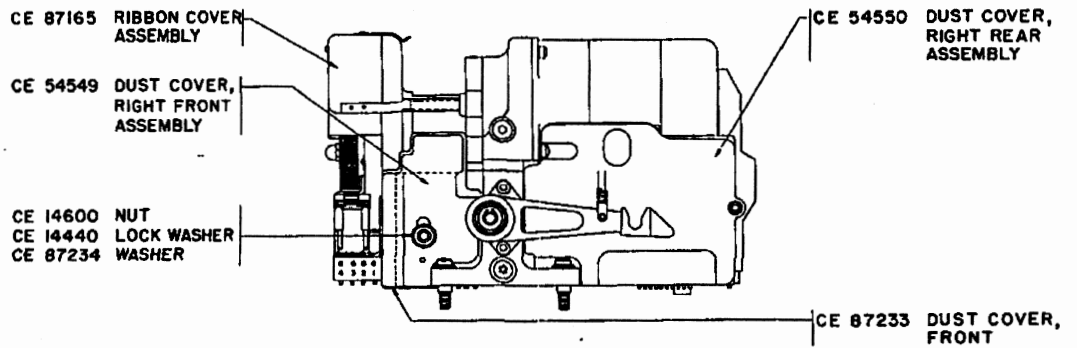
~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



**COVER AND RIBBON REVERSING MECHANISM ASSEMBLY**



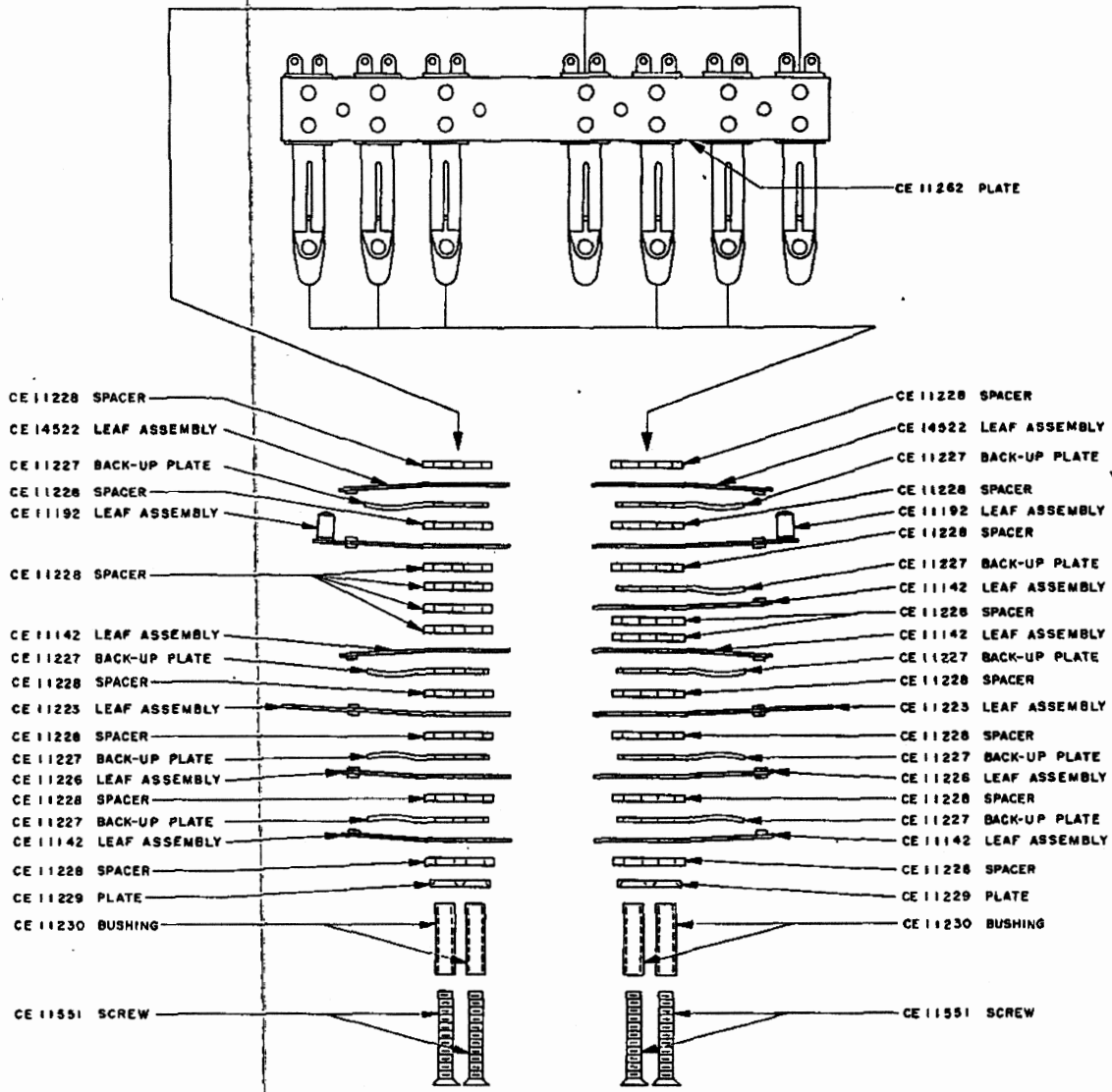
**CE 87059 PRINTER ASSEMBLY**  
(INCLUDES PARTS SHOWN ABOVE PLUS ALL PARTS IN FIGURE 46)

Fig. 47

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



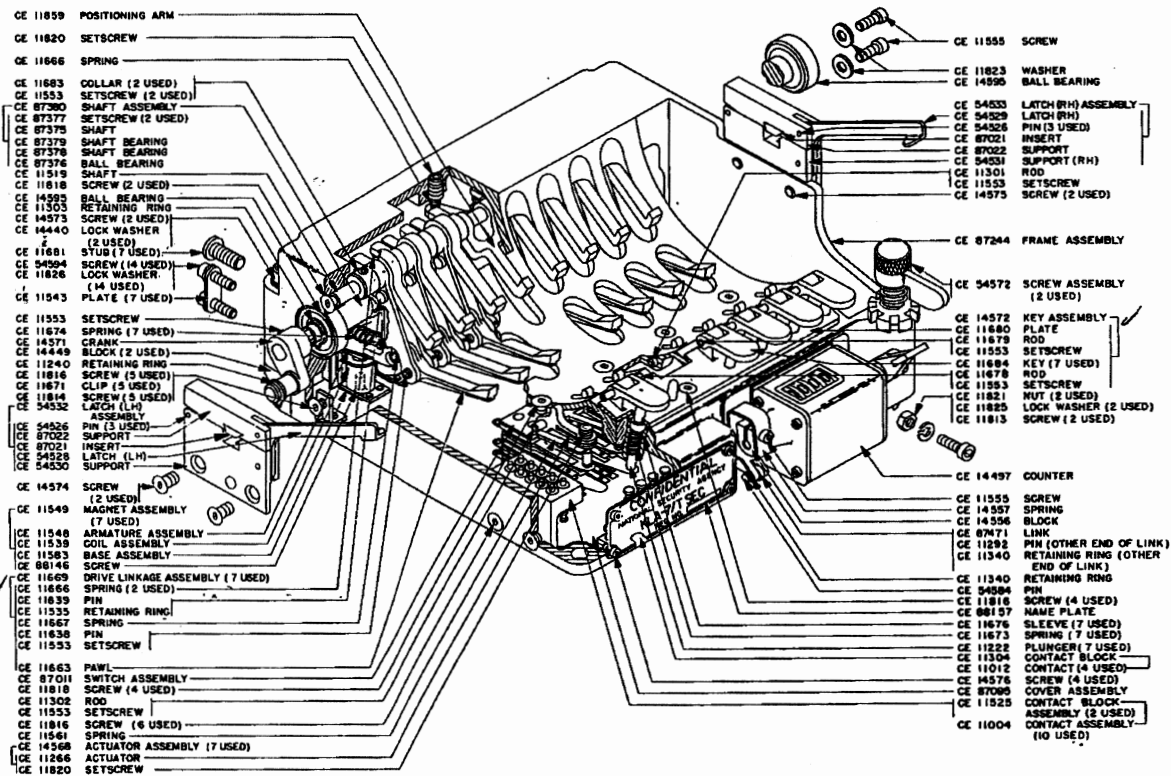
CE 87011 SWITCH ASSEMBLY

Fig. 48

~~CONFIDENTIAL~~

CONFIDENTIAL

CONFIDENTIAL



CE 87068 STEPPING UNIT ASSEMBLY

FIG. 49

253

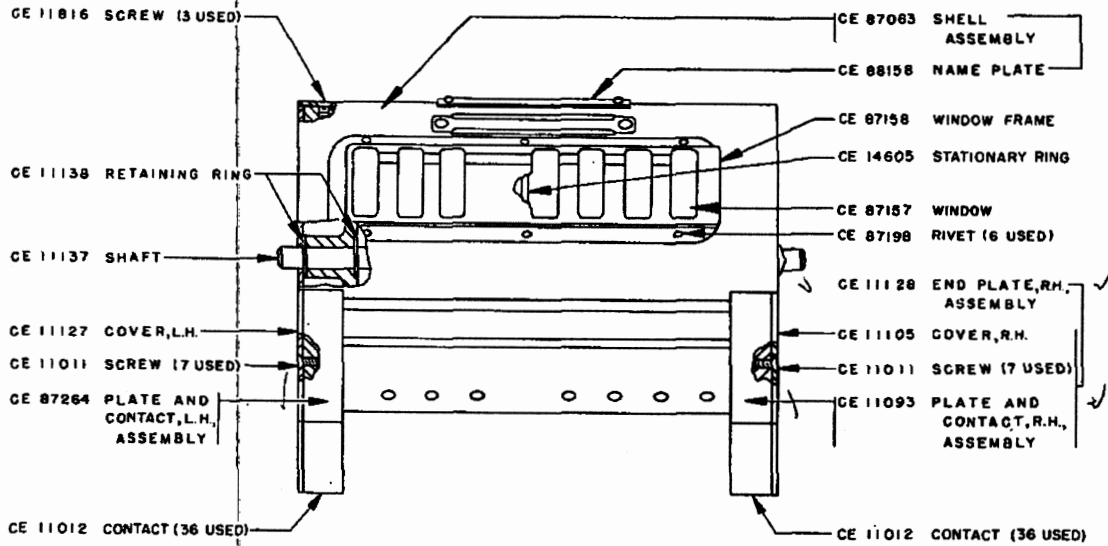
Change No. 1

KAM-1/TSEC



~~CONFIDENTIAL~~

KAM-1/TSEC



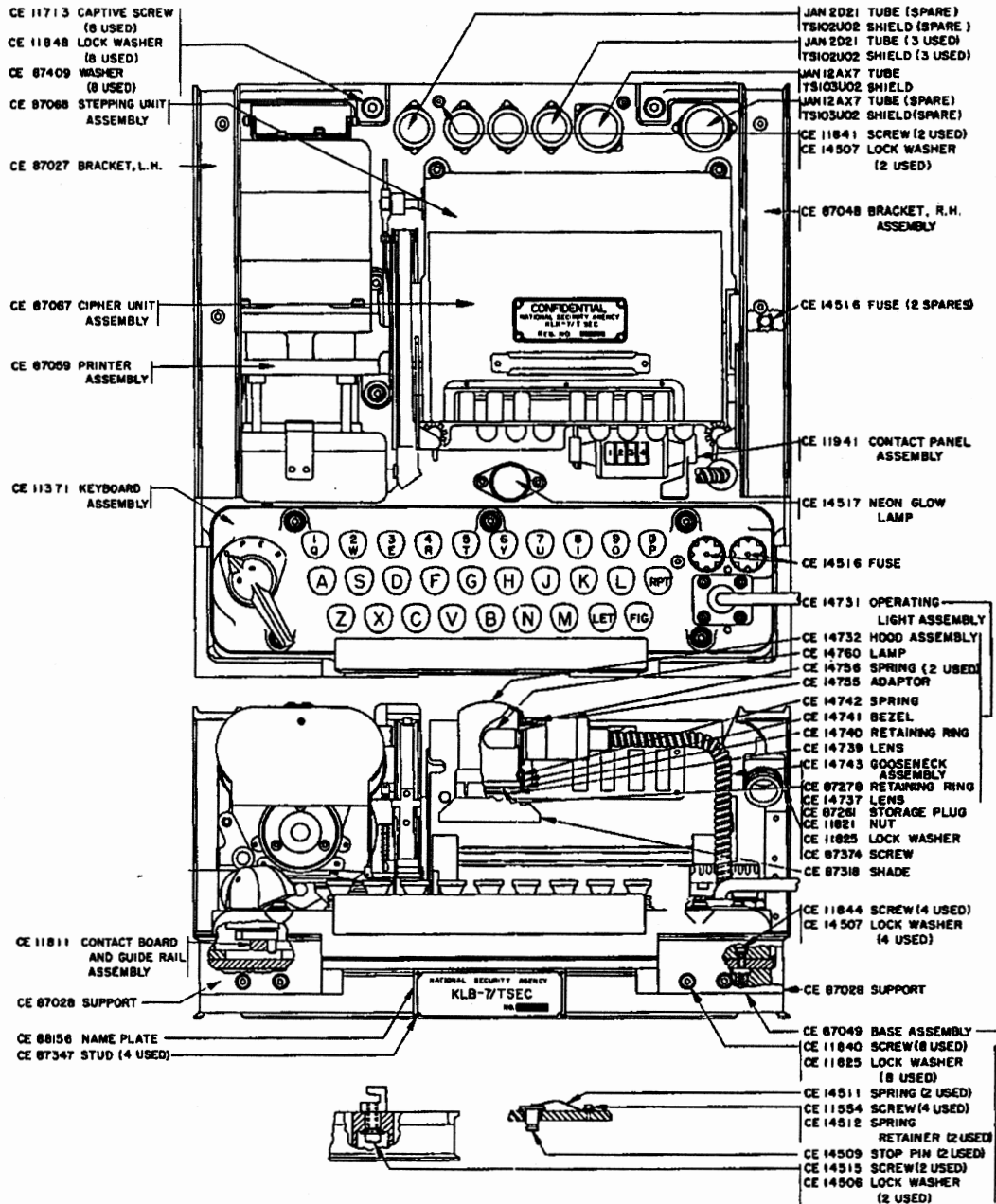
### CE 87067 CIPHER UNIT ASSEMBLY

Fig. 50

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



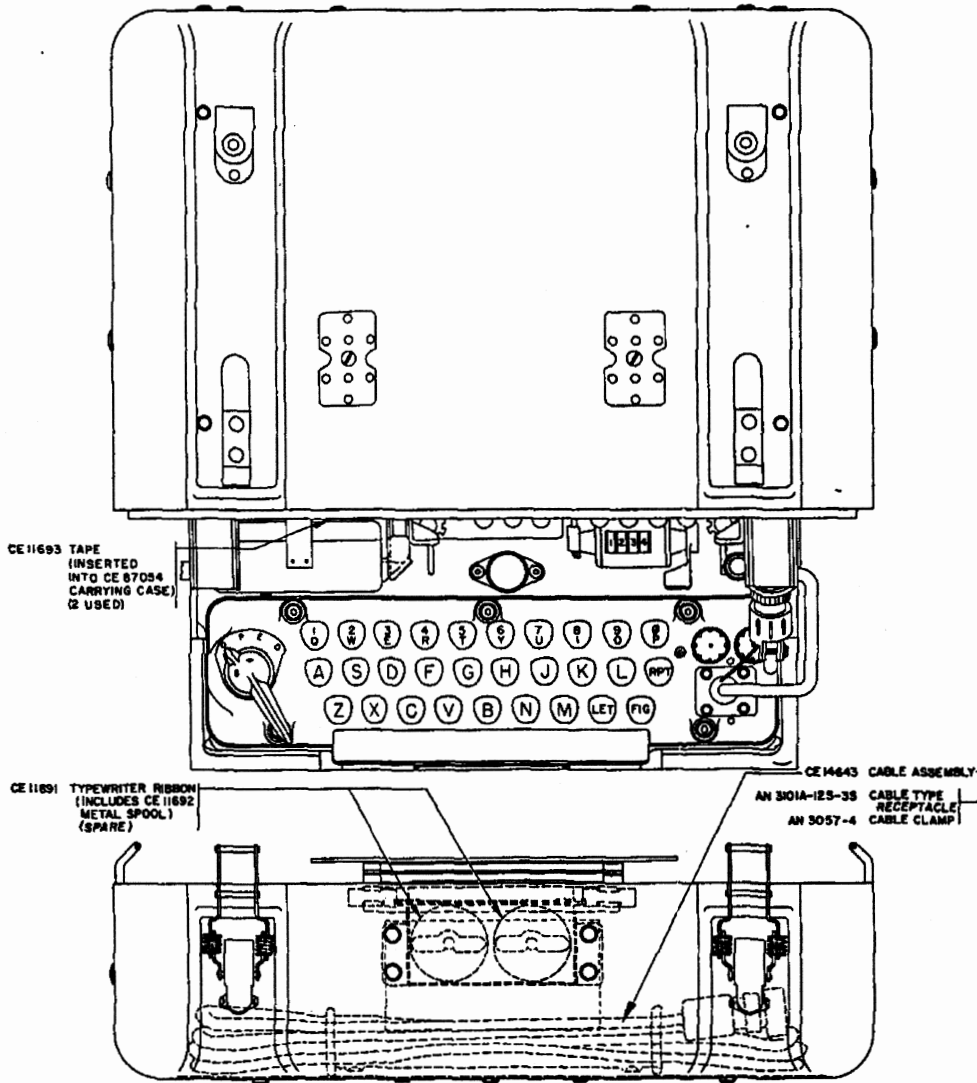
**CE 87077 TSEC/KL-7 CIPHER MACHINE**  
**(Includes Parts Shown Above Plus All Parts in Figure 52)**

Fig. 51

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



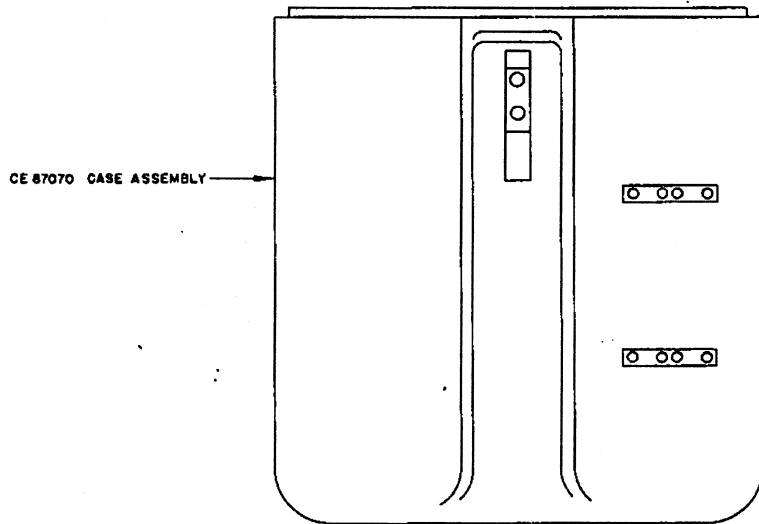
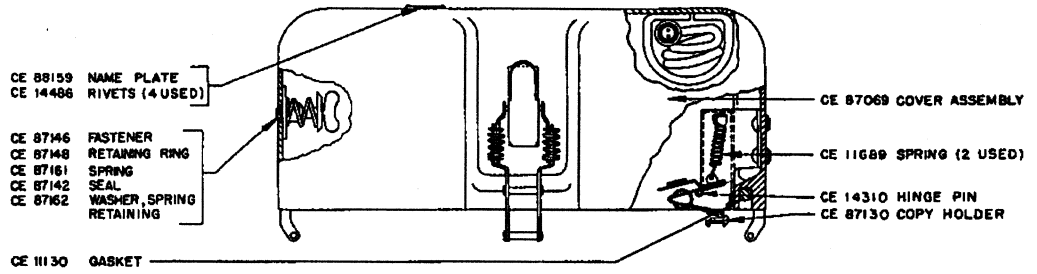
**CE87077 TSEC/KL-7 GIPHER MACHINE**  
**(Includes Parts Shown Above Plus All Parts in Figure 53)**

Fig. 52

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



CE 87054 CARRYING CASE ASSEMBLY

Fig. 53

~~CONFIDENTIAL~~

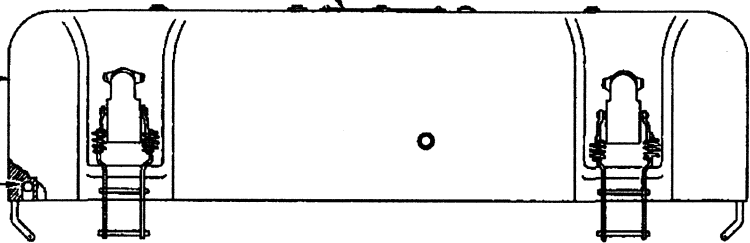
~~CONFIDENTIAL~~

KAM-1/TSEC

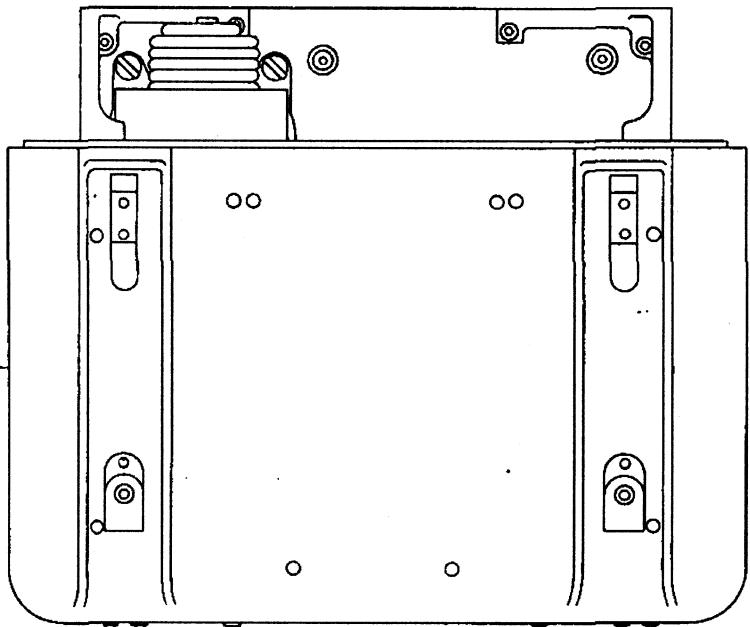
CE 88161 NAME PLATE  
CE 14486 RIVETS (4 USED)

CE 87074 COVER ASSEMBLY

CE 11130 GASKET



CE 87076 CASE ASSEMBLY



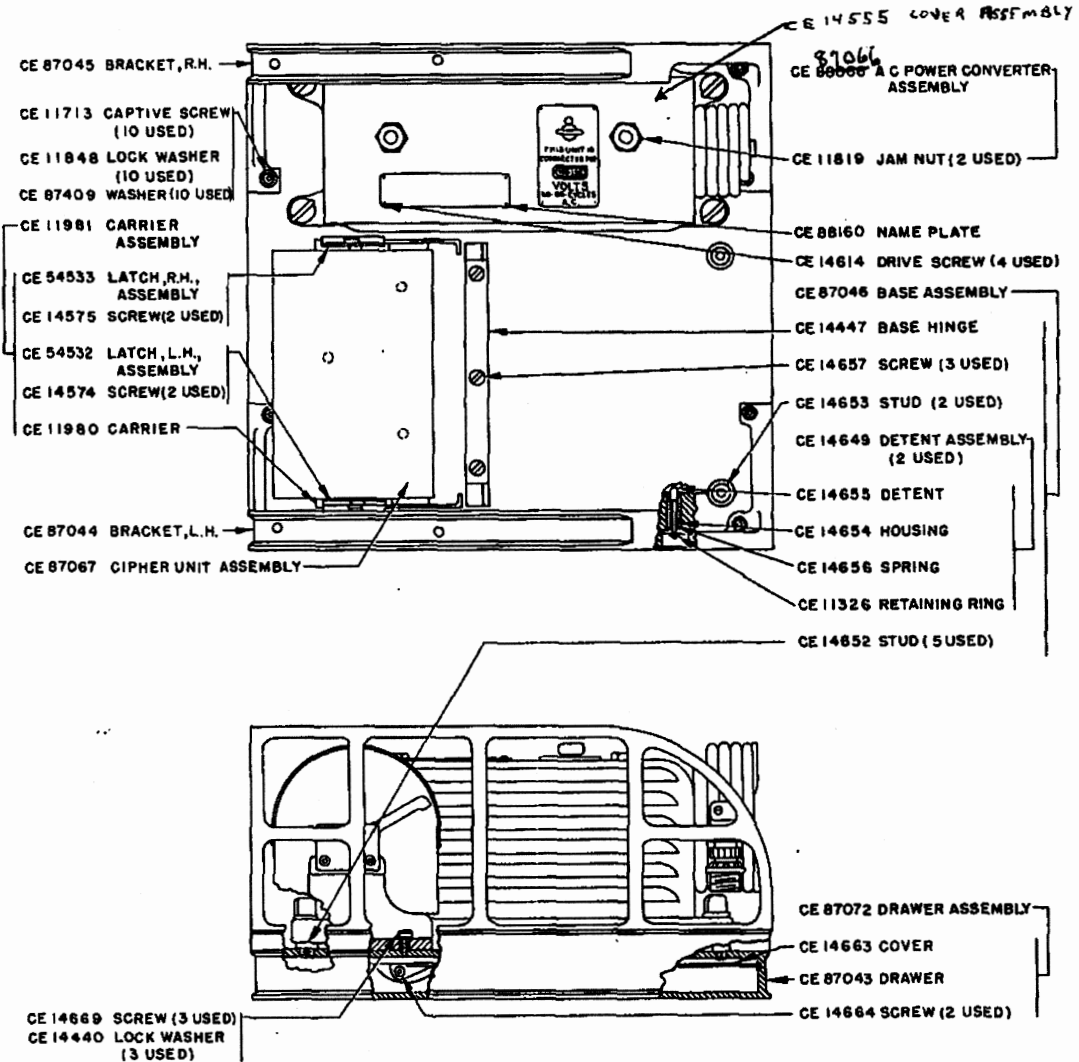
CE 87075 ACCESSORIES AND CASE ASSEMBLY

Fig. 54

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



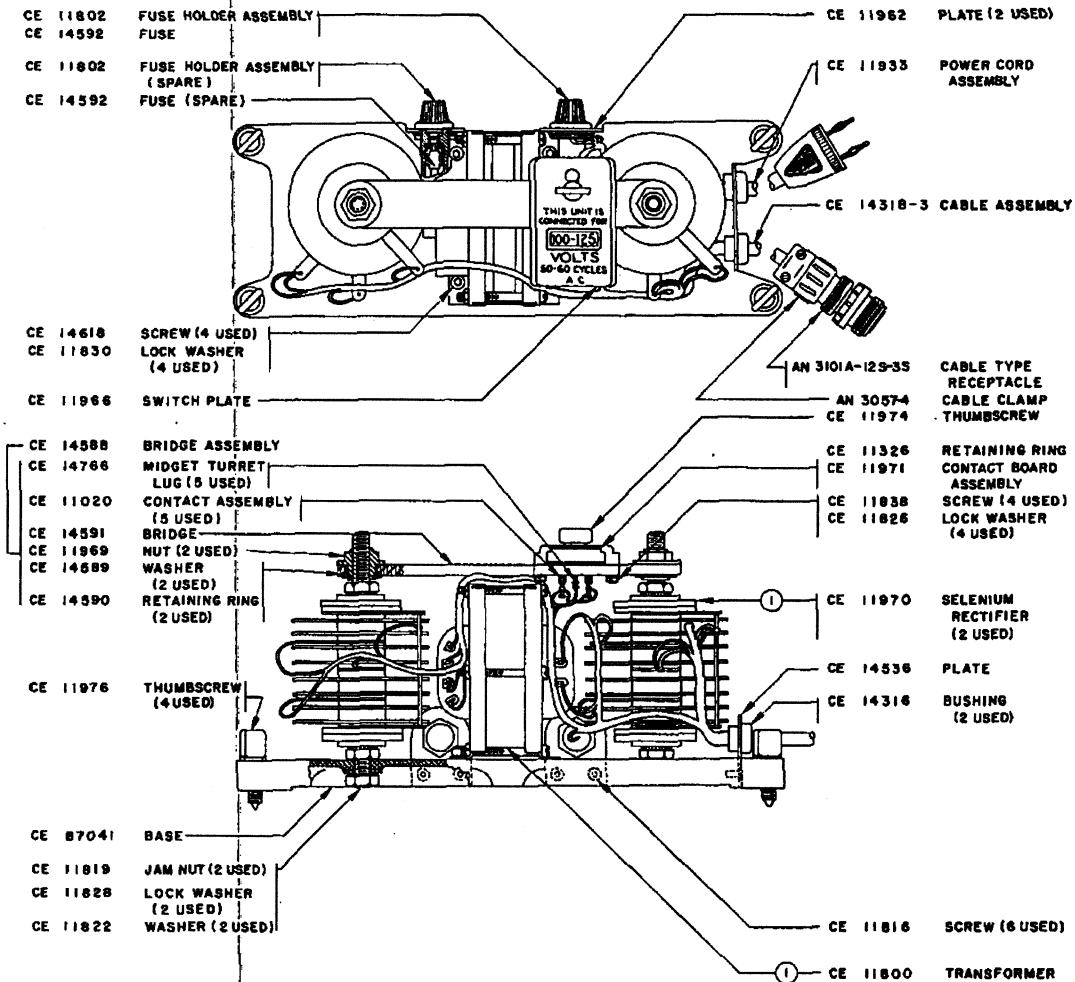
### ACCESSORIES ASSEMBLY

Fig. 55

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



① CE 11970 SELENIUM RECTIFIER AND CE 11800 TRANSFORMER SPECIFICATIONS ARE DIFFERENT FOR CE 87088 AS VARY IN SPECS. POWER-CONVERTER. SEE PARTS LIST.

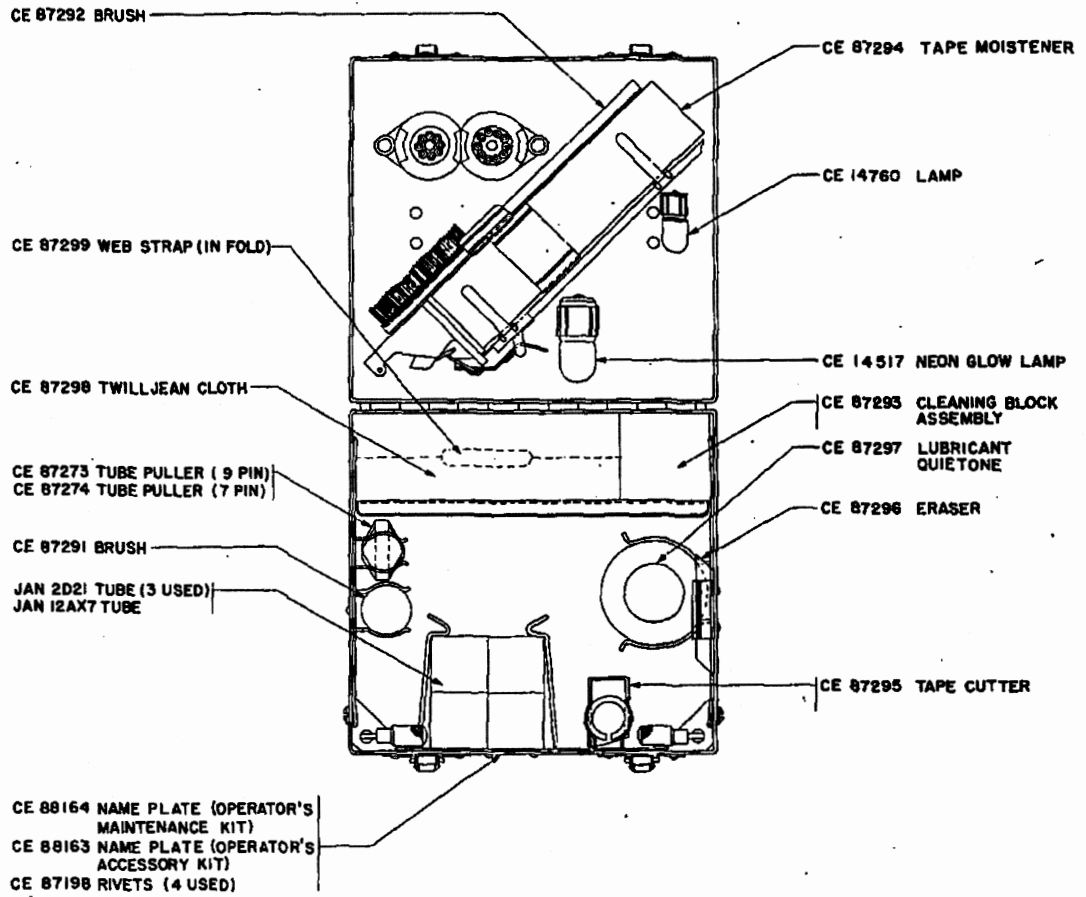
87066  
 CE 88066 AC POWER CONVERTER ASSEMBLY

Fig. 56

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



CE 87290 OPERATOR KIT ASSEMBLY

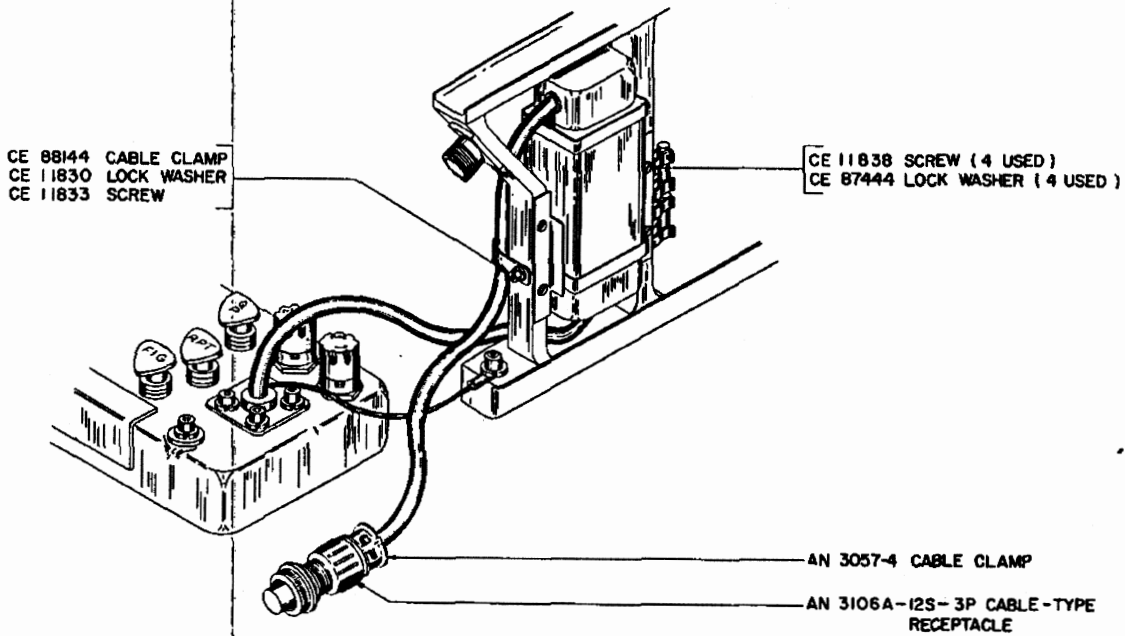
Fig. 57

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC



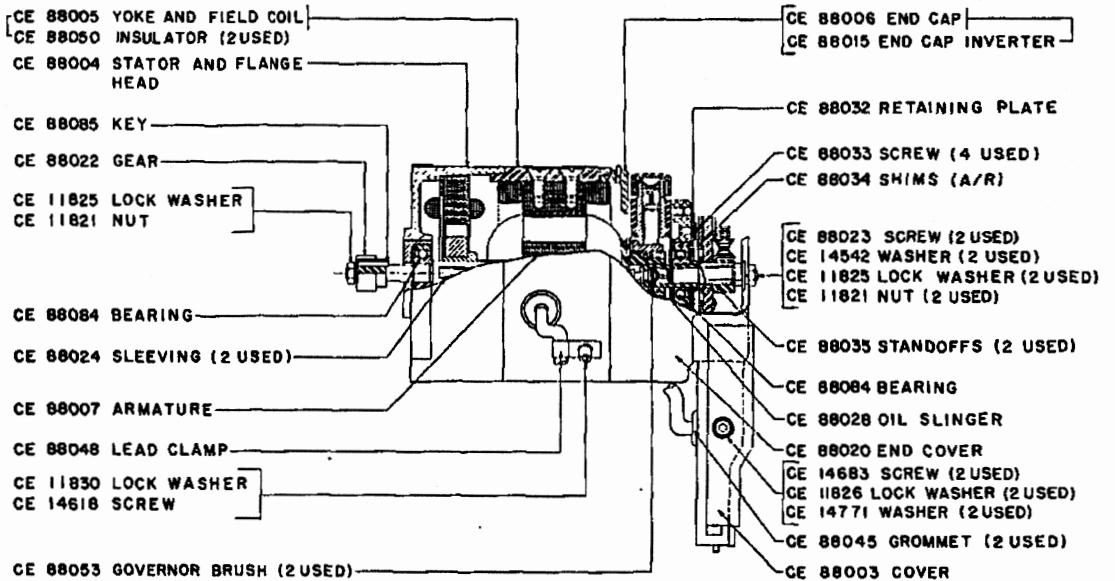
**CE 87422 RADIO INTERFERENCE FILTER**

Fig. 57A (Radio Interference Filter)

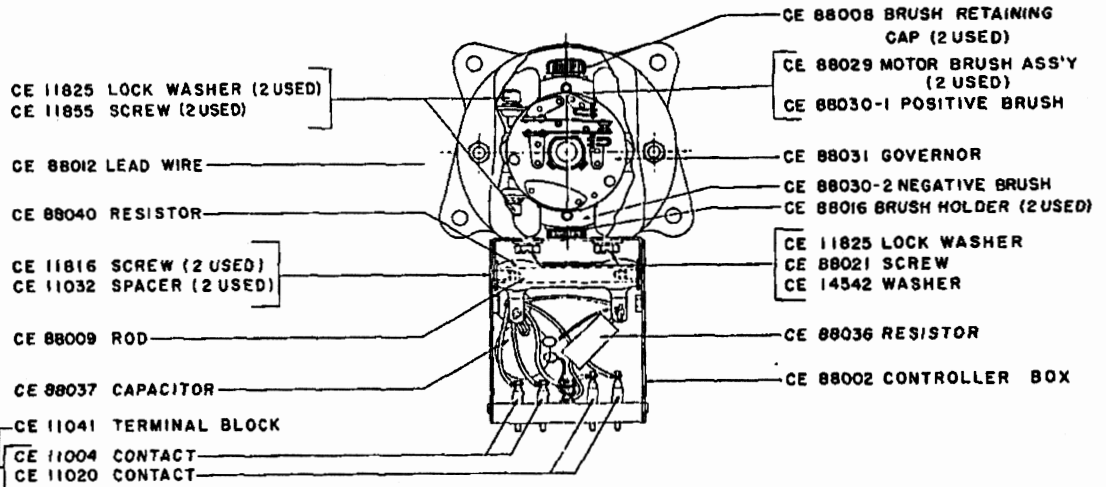
~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC



**CE 88001 MOTOR GENERATOR**



**CE 88000 MOTOR GENERATOR AND CONTROLLER ASSEMBLY**

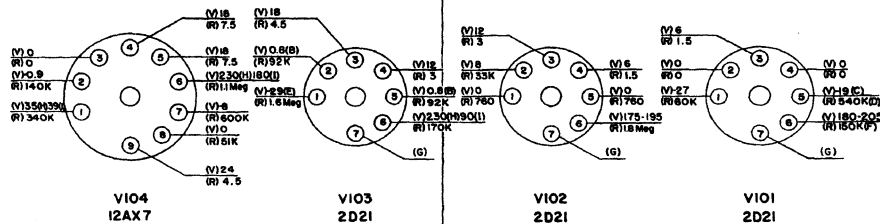
Fig. 57B (new Motor-Generator)

~~CONFIDENTIAL~~



CONFIDENTIAL

KAM-1/TSEC



BOTTOM VIEW OF TERMINALS SHOWN

NOTES:

- A. VOLTAGES MEASURED BETWEEN COMMON BUS AND EACH TUBE SOCKET TERMINAL WITH 20,000 OHMS/VOLT METER.
- B. INCREASES TO 125 VOLTS WHEN FIG KEY IS DEPRESSED.
- C. SHOULD RISE TO 0V WHEN RPT KEY IS DEPRESSED.
- D. DROPS TO 0 OHMS WHEN RPT KEY IS DEPRESSED.
- E. BECOMES 16 VOLTS POSITIVE WHEN FIG KEY IS DEPRESSED.
- F. SELECTOR HANDLE IN P-E-D POSITIONS. NC IN 0 POSITION.
- G. NO CONNECTION.
- H. LETTERS CONDITION
- I. FIGURES CONDITION

CAUTION:

DISCONNECT POWER PRIOR TO READING RESISTANCE.

Folded Page 265  
 Contains  
 TSEC/KL-7 Tube Socket Terminals  
 Figure 99

CONFIDENTIAL

Fig. 99-TSEC/KL-7 Tube Socket Terminals

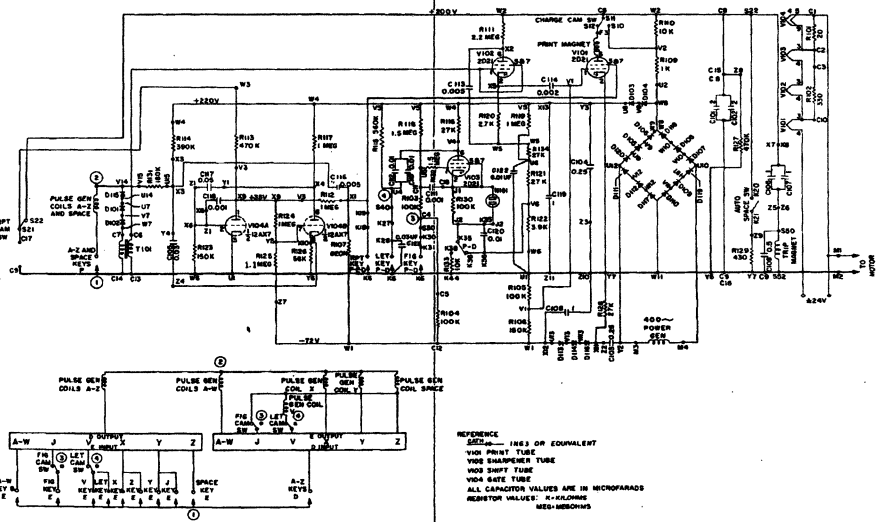
265

Change No. 2  
 Reverse (Page 266) Blank  
 (Change No. 2 to KAM-1/TSEC, 18 May 1960)

CONFIDENTIAL

KAM-1/TSEC

Folded Page 267  
Contains  
TSEC/KL-7 Schematic Diagram  
Figure 60

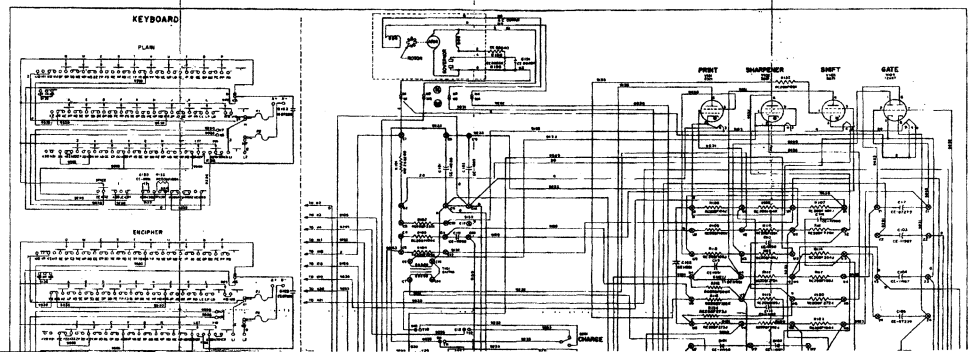


REFERENCE  
 6X4... 1MG OR EQUIVALENT  
 V108 PRINT TUBE  
 V109 SHARPENER TUBE  
 V110 SHUTTLE TUBE  
 V111 BATE TUBE  
 ALL CAPACITOR VALUES ARE IN MICROFARADS  
 RESISTOR VALUES: R-K-OLHMS  
 RES-MSHMS

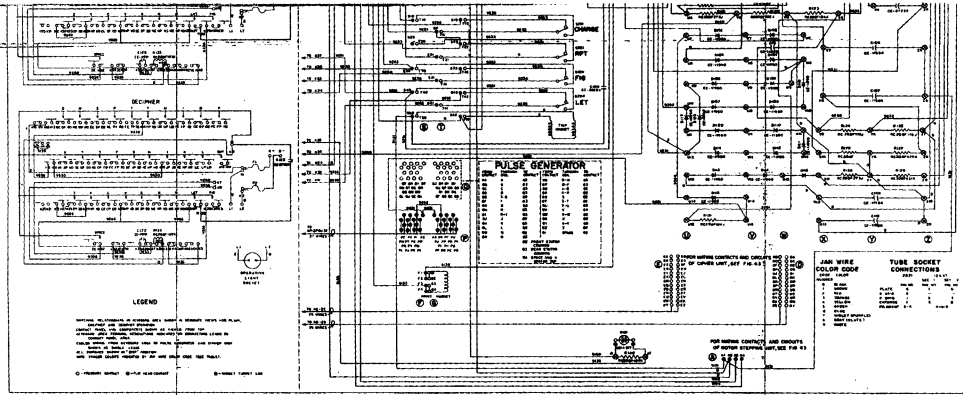
Fig. 60—TSEC/KL-7 Schematic Diagram

CONFIDENTIAL

~~CONFIDENTIAL~~



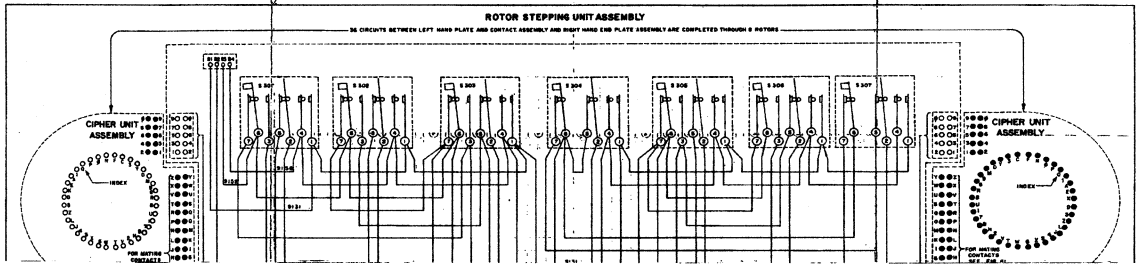
Folded Page 308  
Contains  
T8CCEL-3 Wiring Diagram  
Figure 41



CONFIDENTIAL

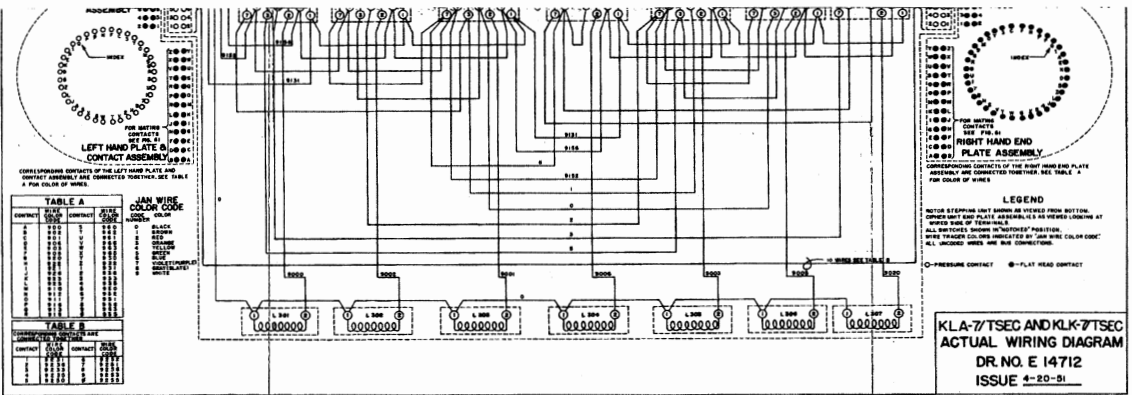
Fig. 41 - T8CCEL-3 Wiring Diagram  
308  
Change No. 3  
Revised (Rev. 270) March  
Change No. 1 to Rev. 270, 14 Jan 1958

COMMERCIAL



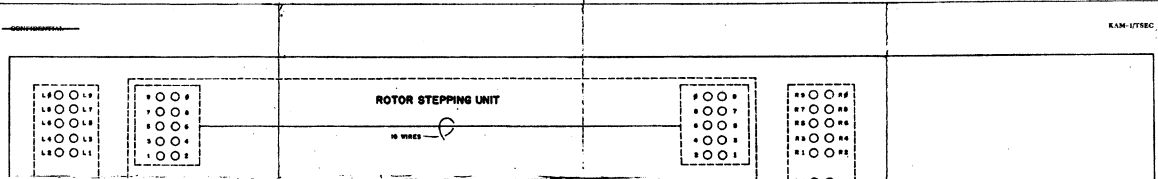


Folded Page 273  
 Contains  
 KLA-7TSEC and KLK-7TSEC Wiring Diagram  
 Figure 43

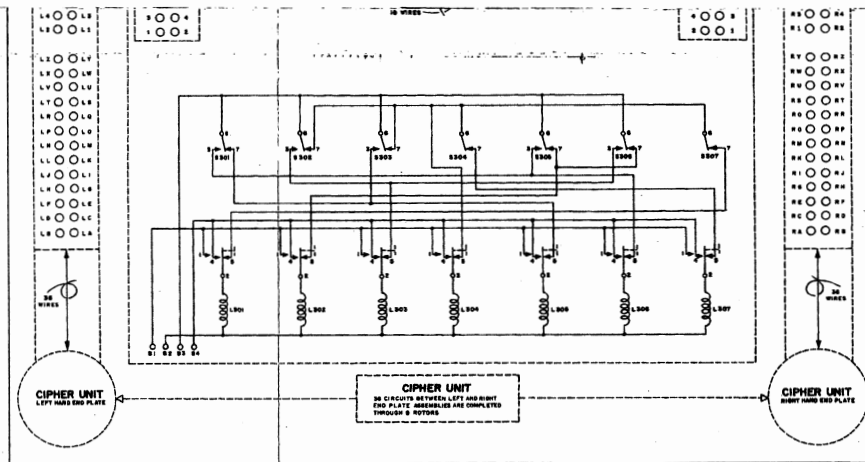


**KLA-7/TSEC and KLK-7/TSEC  
 ACTUAL WIRING DIAGRAM  
 DR. NO. E 14712  
 ISSUE 4-20-51**

Fig. 43- KLA-7/TSEC and KLK-7/TSEC Wiring Diagram  
 273 ORIGINAL  
 Review (Page 273) Blank



Folded Page 271  
 Contains  
 KLA-7/TSEC and KLK-7/TSEC Schematic Diagram  
 Figure 42

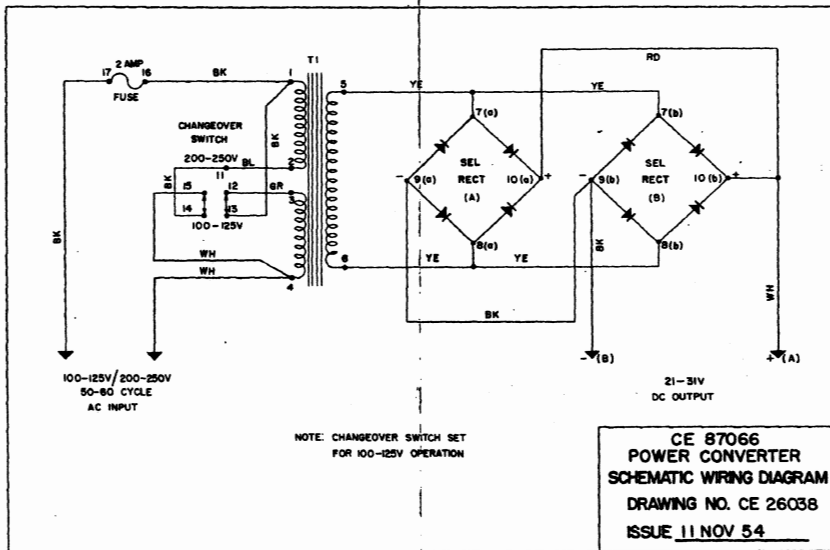


**KLA-7/TSEC & KLK-7/TSEC  
 SCHEMATIC WIRING DIAGRAM**  
 DR. NO. E14714  
 ISSUE 4-20-51

Fig. 42—KLA-7/TSEC and KLK-7/TSEC Schematic Diagram  
 ORIGINAL  
 871  
 Remove (Page 271) Mark

CONFIDENTIAL

Folded Page 275  
 Contains  
 Power Converter Schematic Diagram  
 Figure 64



CONFIDENTIAL

Fig. 64—Power Converter Schematic Diagram

Folded Page 277  
Contains  
Power Converter Wiring Diagram  
Figure 65

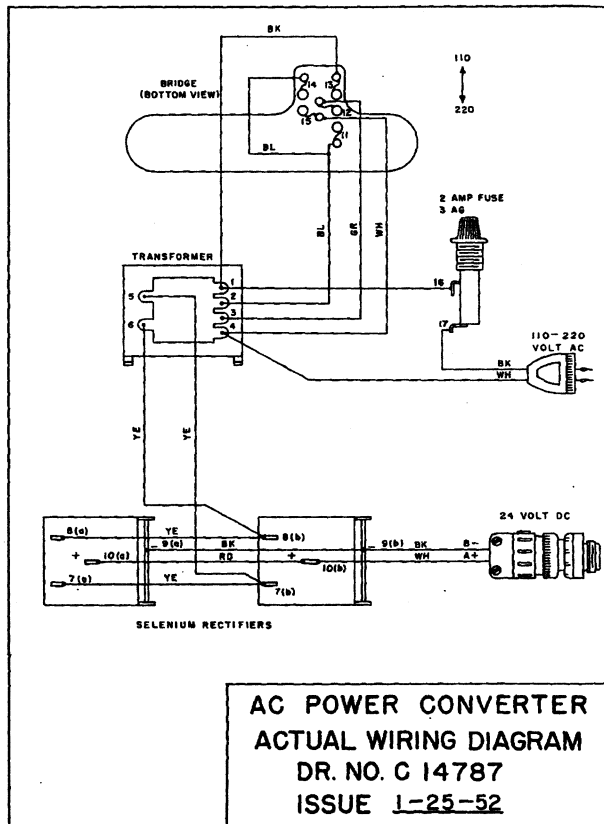
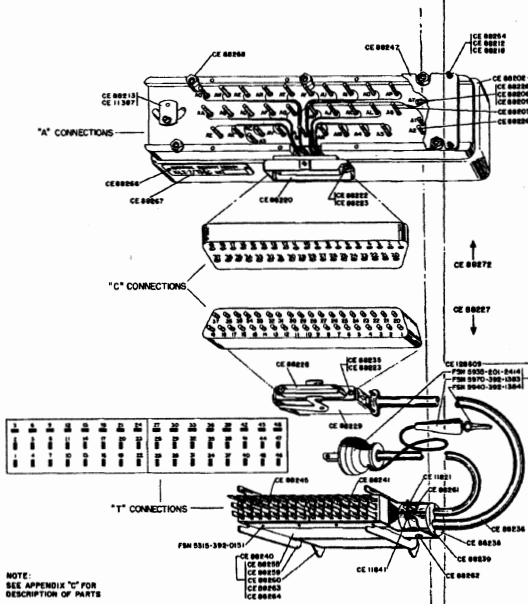


Fig. 65—Power Converter Wiring Diagram

CONFIDENTIAL

KAM-1/TSEC

Folded Page 278.1  
 Contains  
 KLX/TSEC Keyboard Adapter  
 Figure 66



NOTE:  
 SEE APPENDIX "C" FOR  
 DESCRIPTION OF PARTS

CONFIDENTIAL

From Keyboard Terminal	Through Wire	To Keyboard Plug (to Type Reader)	Through Wire	To Decoder Plug (to Type Reader)
AA	9808	CH	9808	T1
AB	9809	CH	9809	T2
AC	9810	CH	9810	T3
AD	9811	CH	9811	T4
AE	9812	CH	9812	T5
AF	9813	CH	9813	T6
AG	9814	CH	9814	T7
AH	9815	CH	9815	T8
AI	9816	CH	9816	T9
AJ	9817	CH	9817	T10
AK	9818	CH	9818	T11
AL	9819	CH	9819	T12
AM	9820	CH	9820	T13
AN	9821	CH	9821	T14
AO	9822	CH	9822	T15
AP	9823	CH	9823	T16
AQ	9824	CH	9824	T17
AR	9825	CH	9825	T18
AS	9826	CH	9826	T19
AT	9827	CH	9827	T20
AU	9828	CH	9828	T21
AV	9829	CH	9829	T22
AW	9830	CH	9830	T23
AX	9831	CH	9831	T24
AY	9832	CH	9832	T25
AZ	9833	CH	9833	T26
AA	9	CH	9	T27
AB	9834	CH	9834	T28
AC	9835	CH	9835	T29
AD	9836	CH	9836	T30
AE	9	CH	9	T31
AF	9	CH	9	T32
AG	9	CH	9	T33
AH	9	CH	9	T34
AI	9	CH	9	T35
AJ	9	CH	9	T36
AK	9	CH	9	T37
AL	9	CH	9	T38
AM	9	CH	9	T39
AN	9	CH	9	T40
AO	9	CH	9	T41
AP	9	CH	9	T42
AQ	9	CH	9	T43
AR	9	CH	9	T44
AS	9	CH	9	T45
AT	9	CH	9	T46
AU	9	CH	9	T47
AV	9	CH	9	T48
AW	9	CH	9	T49
AX	9	CH	9	T50
AY	9	CH	9	T51
AZ	9	CH	9	T52
AA	9	CH	9	T53
AB	9	CH	9	T54
AC	9	CH	9	T55
AD	9	CH	9	T56
AE	9	CH	9	T57
AF	9	CH	9	T58
AG	9	CH	9	T59
AH	9	CH	9	T60
AI	9	CH	9	T61
AJ	9	CH	9	T62
AK	9	CH	9	T63
AL	9	CH	9	T64
AM	9	CH	9	T65
AN	9	CH	9	T66
AO	9	CH	9	T67
AP	9	CH	9	T68
AQ	9	CH	9	T69
AR	9	CH	9	T70
AS	9	CH	9	T71
AT	9	CH	9	T72
AU	9	CH	9	T73
AV	9	CH	9	T74
AW	9	CH	9	T75
AX	9	CH	9	T76
AY	9	CH	9	T77
AZ	9	CH	9	T78
AA	9	CH	9	T79
AB	9	CH	9	T80
AC	9	CH	9	T81
AD	9	CH	9	T82
AE	9	CH	9	T83
AF	9	CH	9	T84
AG	9	CH	9	T85
AH	9	CH	9	T86
AI	9	CH	9	T87
AJ	9	CH	9	T88
AK	9	CH	9	T89
AL	9	CH	9	T90
AM	9	CH	9	T91
AN	9	CH	9	T92
AO	9	CH	9	T93
AP	9	CH	9	T94
AQ	9	CH	9	T95
AR	9	CH	9	T96
AS	9	CH	9	T97
AT	9	CH	9	T98
AU	9	CH	9	T99
AV	9	CH	9	T100

COLOR CODES  
 B-BLACK  
 G-GREEN  
 R-RED  
 L-PALE  
 W-WHITE  
 Y-YELLOW  
 G-GRAY (SLATE)

Fig. 66--KLX-7/TSEC Keyboard Adapter  
 278.1  
 Change No. 2  
 Reverse (Page 278.2) Blank  
 (Change No. 2 to KAM-1/TSEC, 15 MAY 1962)

~~CONFIDENTIAL~~

KAM-1/TSEC

## 9100—LISTS OF REPLACEMENT PARTS

9101. List of Common Parts by Types.—This is a tabulation of common parts such as screws nuts, bolts, washers, shims, springs, etc. It appears on pages 281 thru 283.

9102. Numerical List of Parts.—This list indicates the part number, name and description of the part, quantity used, the number of the assembly on which the part is used, and the number of the figure which illustrates the part. It appears on pages 285 thru 299.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## LIST OF COMMON PARTS BY TYPES

## SCREWS

CE 11814.....#2-56 x 0.125" lg; steel; FH, csk, hex socket drive  
 CE 11554.....#2-56 x 0.187" lg; steel; Flat Fil H, hex socket drive  
 CE 14576.....#2-56 x 0.187" lg; steel; Flat Fil H, hex socket drive; 0.273" loa  
 CE 11011.....#2-56 x 0.250" lg; steel; FH, csk, hex socket drive  
 CE 14664.....#4-40 x 0.109" lg; SST; Hex H, 0.250" w across flats; shldr 0.156" dia x 0.060" lg; special  
 CE 11553.....#4-40 x 0.125" loa; setscrew; steel; headless, hex socket drive; cup point  
 CE 11851.....#4-40 x 0.156" lg; setscrew; steel; headless, hex socket drive; cup point  
 CE 14683.....#4-40 x 0.187" lg; steel; Flat Fil H, hex socket drive; 0.299" loa  
 CE 11839.....#4-40 x 0.187" lg; setscrew; steel; headless, hex socket drive; cup point  
 CE 11816.....#4-40 x 0.250" lg; steel; FH, csk, hex socket drive  
 CE 11412.....#4-40 x 0.250" lg; screw steel; Flat Fil H, hex socket drive; 0.362" loa  
 CE 11555.....#4-40 x 0.312" lg; steel; Flat Fil H, hex socket drive; 0.424" loa  
 CE 87377.....#4-40 x 0.312" lg; setscrew; steel, cad. pl; headless, hex socket drive; cup point  
 CE 54594.....#4-40 x 0.349" lg; steel; Flat Fil H, hex socket drive; 0.455" loa  
 CE 11818.....#4-40 x 0.375" lg; steel; FH, csk, hex socket drive  
 CE 11556.....#4-40 x 0.375" lg; steel; Flat Fil H, hex socket drive; 0.487" loa  
 CE 11838.....#4-40 x 0.437" lg; steel; Flat Fil H, hex socket drive; 0.546" loa  
 CE 11836.....#4-40 x 0.531" lg; steel; FH, csk, hex socket drive  
 CE 11551.....#4-40 x 0.781" lg; steel; FH, csk, hex socket drive  
 CE 14480.....#6-32 x 0.188" lg; brass, nickel pl; Bind. H, slot drive; 0.282" loa  
 CE 14574.....#6-32 x 0.188" loa; steel; FH, csk, hex socket drive  
 CE 11855.....#6-32 x 0.250" lg; steel; Flat Fil H, hex socket drive; 0.388" loa  
 CE 14575.....#6-32 x 0.250" loa; steel; FH, csk, hex socket drive  
 CE 11832.....#6-32 x 0.312" lg; steel; Flat Fil H, hex socket drive; 0.450" loa  
 CE 11846.....#6-32 x 0.375" lg; steel; FH, csk, hex socket drive  
 CE 11813.....#6-32 x 0.375" lg; steel; Flat Fil H, hex socket drive; 0.513" loa  
 CE 11840.....#6-32 x 0.437" lg; steel; Flat Fil H, hex socket drive; 0.575" loa  
 CE 11841.....#6-32 x 0.500" lg; steel; Flat Fil H, hex socket drive; 0.638" loa  
 CE 11844.....#6-32 x 0.625" lg; steel; Flat Fil H, hex socket drive; 0.763" loa  
 CE 87374.....#6-32 x 0.625" loa; steel; FH, csk, hex socket drive  
 CE 14710.....#8-32 x 0.156" lg; setscrew; steel; headless, hex socket drive; cup point  
 CE 54521.....#8-32 x 0.187" lg; steel; Flat Fil H, hex socket drive; 0.351" loa  
 CE 14618.....#8-32 x 0.250" lg; steel; Flat Fil H, hex socket drive  
 CE 11820.....#8-32 x 0.250" lg; setscrew; steel; headless, hex socket drive; oval point  
 CE 11464.....#8-32 x 0.375" lg; CS, cad. pl; Hex H, no slot, 0.500" w across flats; 0.437" loa  
 CE 11833.....#8-32 x 0.375" lg; steel; Flat Fil H, hex socket drive; 0.539" loa  
 CE 87447.....#8-32 x 0.500" lg; steel, cad. pl; cone shaped head, hex socket drive; 0.638" loa  
 CE 11842.....#8-32 x 0.500" lg; steel; Flat Fil H, hex socket drive; 0.664" loa  
 CE 11965.....#8-32 x 1.125" lg; steel; Flat Fil H, hex socket drive; gimlet point  
 CE 14515.....#10-32 x 0.313" lg; steel; Flat Fil H, hex socket drive; 0.503" loa  
 CE 14657.....#10-32 x 0.375" lg; steel; FH, csk, hex socket drive  
 CE 14669.....#10-32 x 0.500" lg; steel; Flat Fil H, hex socket drive; 0.690" loa  
 CE 11974.....#10-32 x 1.000" loa; thumbscrew; SST; head 0.572" lg x 0.500" w, flat sides; thd 0.305" lg;  
 flat tip, unthreaded, 0.118" dia with groove  
 CE 14573.....#10-32 x 1.500" lg; steel; Fil H, hex socket drive; 1.690" loa  
 CE 11687.....#10-32 x 0.340" lg; SST; round knurled head, hex socket drive, shldr 0.035" lg; unthreaded  
 portion 0.140" dia x 0.625" lg; special  
 CE 11713.....¼-20 x 0.500" lg; captive screw; steel; Flat Fil H, 0.375" dia x 0.250" lg, hex socket drive;  
 shldr 0.250" x 0.047" lg; unthreaded portion 0.185" dia x 0.703" lg; 1.500" loa  
 CE 11976.....¼-20 x 0.281" lg; thumbscrew; SST; head 0.625" w x 0.563" lg; 1.500" loa; gimlet point  
 CE 14614.....0.058" dia x 0.125" lg; drive, screw; steel, cad. pl; RH; Parker-Kalon

## NUTS

CE 11552.....#4-40; hex; steel; 0.093" thk; 0.250" w across flats  
 CE 11821.....#6-32; hex; steel; 0.093" thk; 0.250" w across flats  
 CE 14441.....#8-32; hex; steel; 0.125" thk; 0.312" w across flats  
 CE 11847.....#8-32; hex, acorn; SST; 0.310" high; 0.312" w across flats  
 CE 14600.....#10-32; hex; SST; 0.187" thk; 0.375" w across flats

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

- CE 11969..... $\frac{1}{8}$ -18; hex; SST; hex portion 0.563" w across flats; middle portion round, 0.875" OD x 0.062" lg; one end 0.495" OD x 0.268" lg; 0.562" loa; special
- CE 11819..... $\frac{1}{8}$ -18; hex; steel; 0.203" thk; 0.594" w across flats
- CE 54534..... $\frac{1}{8}$ -32; hex; SST; 0.500" w across flats; one side tapered shldr 0.420" OD x 0.068" lg, csk; other side shldr 0.500" OD x 0.015" lg, csk; 0.219" thk
- CE 11163..... $\frac{1}{8}$ -32; round; brass, nickel pl; slotted; 0.437" OD; 0.093" thk
- CE 14799..... $\frac{1}{2}$ -32; hex; CRS; 0.093" thk; 0.562" w across flats
- CE 11248..... $\frac{1}{2}$ -32; hex; SST; 0.093" thk; 0.625" w across flats
- CE 11311..... $\frac{1}{8}$ -32; hex; brass; 0.125" thk; 0.687" w across flats

**LOCK WASHERS**

- CE 14440.....#10 ID; CS; round, slit helical ring
- CE 11826.....0.115" ID; CS; round, slit helical ring; 0.212" OD; 0.025" thk
- CE 11825.....0.141" ID; CS; round, slit helical ring; 0.251" OD; 0.031" thk
- CE 14507.....0.146" ID; steel; internal teeth; 0.250" OD; 0.018" thk; Shakeproof # 1206-01
- CE 11830.....0.168" ID; CS; round, slit helical ring; 0.296" OD; 0.040" thk
- CE 14506.....0.200" ID; steel; external and internal teeth; 0.502" OD; 0.025" thk; Shakeproof # 4010-14
- CE 11848.....0.250" ID; CS; round, slit helical ring; 0.500" OD; 0.062" thk
- CE 11828.....0.319" ID; CS; round, slit helical ring; 0.575" OD; 0.056" thk
- CE 14768.....0.508" ID; steel; internal teeth; 0.625" OD; 0.022" thk; Shakeproof # 1224-02
- CE 54568.....0.520" ID; steel; internal teeth; 0.781" OD; 0.010" thk; Shakeproof # 1224-08
- CE 54548.....0.530" ID; steel; internal teeth; 0.770" OD; 0.029" thk; Shakeproof # 1226-03-00
- CE 11449.....0.280" sq ctr hole; SST; 0.500" OD with 2 tab extensions 0.125" w; 0.031" thk

**FLAT WASHERS**

- CE 87230.....0.115" ID; CS; 0.174" OD; 0.025" thk
- CE 11602.....0.125" ID; phosphor bronze; 0.250" OD; 0.016" thk
- CE 14771.....0.130" ID; steel; 0.250" OD; 0.031" thk
- CE 11823.....0.120" ID; steel; 0.343" OD; 0.031" thk
- CE 54500.....0.188" ID; CS; 0.375" OD; 0.025" thk
- CE 87287.....0.190" ID; blue tempered spring steel; 0.563" OD; 0.006" thk
- CE 87234.....0.203" ID; steel; 0.438" OD; 0.031" thk
- CE 14491.....Center tapped # 8-32; round; aluminum; 0.437" OD; 0.032" thk; bright red
- CE 87409.....0.265" ID; corrosion resisting steel; 0.500" OD; 0.032" thk
- CE 11822.....0.328" ID; steel; 0.750" OD; 0.063" thk
- CE 14589.....0.500" ID; steel; 0.750" OD; 0.062" thk

**SPRINGS**

- CE 11195.....0.012" dia SST spring wire; helical extension; cyl; 15 coils; test 4 oz at 0.500"; 0.125" OD; 0.375" loa
- CE 11238.....0.031" dia SST spring wire; helical compression; cyl; 13 coils; no test; 0.122" ID; 0.184" OD; 0.750" lg
- CE 11322.....0.023" dia beryllium copper spring wire, silver pl; helical compression; tapered; 4 coils; no test; one end 0.141" ID, 0.187" OD; other end 0.212" ID, 0.258" OD
- CE 11520.....0.032" dia SST spring wire; helical compression; cyl; 5 coils; no test; 0.188" ID; 0.252" OD; 0.500" lg
- CE 11617.....0.020" dia SST spring wire; helical compression; cyl; 14 coils; no test; 0.141" ID; 0.181" OD; 0.625" lg
- CE 11626.....0.032" dia SST spring wire; helical torsion; cyl; 4 coils; no test; 0.351" ID; 0.415" OD; 0.156" lg
- CE 11629.....0.015" dia SST wire; helical extension; cyl; 10 coils; test 12 oz at 0.510"; 0.095" ID; 0.125" OD; 0.400" loa
- CE 11630.....0.012" dia SST spring wire; helical compression; cyl; 12 coils; no test; 0.076" ID; 0.100" OD; 0.406" lg
- CE 11646.....0.032" dia SST spring wire; helical torsion; cyl; 4- $\frac{1}{2}$  coils; no test; 0.281" ID; 0.218" lg; 0.531" loa
- CE 11666.....0.017" dia SST spring wire; helical compression; cyl; 11 coils; no test; 0.085" ID; 0.120" OD; 0.397" lg
- CE 11667.....0.014" dia SST spring wire; helical extension; cyl; 12 coils; test 18 oz at 0.625"; 0.097" ID; 0.125" OD; 0.208" lg; 0.394" loa

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

CE 11673.....0.016" dia SST spring wire; helical compression; cyl; 9 coils; no test; 0.148" ID; 0.180" OD;  
 0.500" lg  
 CE 11674.....0.016" dia SST spring wire; helical extension; cyl; 29 coils; test 5 oz at 0.875"; 0.155" ID; 0.187"  
 OD; 0.470" lg; 0.642" loa  
 CE 11689.....0.020" dia SST spring wire; helical extension; cyl; 36 coils; test 13 oz at 1.550"; 0.147" ID;  
 0.187" OD; 0.700" lg; 1.000" loa  
 CE 11694.....0.025" dia SST spring wire; helical compression; cyl; 45 coils; no test; 0.187" ID; 0.187" OD;  
 1.125" lg  
 CE 11698.....0.014" dia SST spring wire; helical extension; cyl; 13 coils; test 7- $\frac{1}{10}$  oz at 0.125"; 0.097" ID;  
 0.125" OD; 0.182" lg; 0.562" loa  
 CE 14488.....0.014" dia beryllium pre-tempered spring wire; helical compression; cyl; 8 coils; no test; 0.122"  
 ID; 0.150" OD; 0.468" lg  
 CE 14656.....0.022" dia SST spring wire; helical compression; cyl; 11 coils; no test; 0.143" ID; 0.187" OD;  
 0.750" lg  
 CE 54544.....0.010" dia SST wire; helical extension; cyl; 80 coils; test 3- $\frac{1}{2}$  oz at 1.550"; 0.073" ID; 0.093"  
 OD; 1.000" loa  
 CE 54592.....0.030" dia SST wire; helical compression; cyl; 4 coils; no test; 0.580" ID; 0.640" OD; 0.875" lg  
 CE 87136.....0.035" dia SST wire; helical compression; cyl; 3- $\frac{1}{2}$  coils; no test; 0.570" ID; 0.640" OD; 0.750"  
 lg  
 CE 87161.....0.044" dia SST spring wire; helical compression; cyl; 3 coils; no test; 0.662" ID; 0.750" OD;  
 0.875" lg  
 CE 87229.....0.022" dia SST wire; helical extension; cyl; 20 coils; test 1 lb 2 oz at 0.875"; 0.111" ID; 0.155"  
 OD

~~CONFIDENTIAL~~

NUMERICAL LIST OF PARTS

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
RW29G200	Resistor, Fixed: WW; tubular; 20 ohms $\pm$ 10%; 8 watt; 1.750" lg x 0.500" dia; tab term. each end; JAN-R-26B	1	CE 11941	39
RC20BF102K	Resistor, Fixed, Composition: cyl, carbon; 1,000 ohms $\pm$ 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF103K	Resistor, Fixed Composition: cyl, carbon; 10,000 ohms $\pm$ 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	2	CE 11941	39
RC20BF104J	Resistor, Fixed, Composition: cyl, carbon; 100,000 ohms $\pm$ 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF104K	Resistor, Fixed, Composition: cyl, carbon; 100,000 ohms $\pm$ 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	3	CE 11941	39
RC20BF105J	Resistor, Fixed, Composition: cyl, carbon; 1.0 megohm $\pm$ 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	4	CE 11941	39
RC20BF116J	Resistor, Fixed, Composition: cyl, carbon; 1.1 megohms $\pm$ 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; JAN-R-11	1	CE 11941	39
RC20BF154J	Resistor, Fixed, Composition: cyl, carbon; 150,000 ohms $\pm$ 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF154K	Resistor, Fixed, Composition: cyl, carbon; 150,000 ohms $\pm$ 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF155K	Resistor, Fixed, Composition: cyl, carbon; 1.5 megohms $\pm$ 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	2	CE 11941	39
RC20BF184J	Resistor, Fixed, Composition: cyl, carbon; 180,000 ohms $\pm$ 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF225K	Resistor, Fixed, Composition: cyl, carbon; 2.2 megohms $\pm$ 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF272K	Resistor, Fixed, Composition: cyl, carbon; 2,700 ohms $\pm$ 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF273J	Resistor, Fixed, Composition: cyl, carbon; 27,000 ohms $\pm$ 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	3	CE 11941	39
RC20BF273K	Resistor, Fixed, Composition: cyl, carbon; 27,000 ohms $\pm$ 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF392J	Resistor, Fixed, Composition: cyl, carbon; 3,900 ohms $\pm$ 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF394J	Resistor, Fixed, Composition: cyl, carbon; 390,000 ohms $\pm$ 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF431K	Resistor, Fixed, Composition: cyl, carbon; 430 ohms $\pm$ 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF474J	Resistor, Fixed, Composition: cyl, carbon; 470,000 ohms $\pm$ 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
RC20BF474K	Resistor, Fixed, Composition: cyl, carbon; 470,000 ohms ± 10%; 1/2 watt; 0.468" lg x 0.249" dia; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF563J	Resistor, Fixed, Composition: cyl, carbon; 56,000 ohms ± 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF564K	Resistor, Fixed, Composition: cyl, carbon; 560,000 ohms ± 10%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC20BF824J	Resistor, Fixed, Composition: cyl, carbon; 820,000 ohms ± 5%; 1/2 watt; 0.249" dia x 0.468" lg; 0.028" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
RC30BF331K	Resistor, Fixed, Composition: cyl, carbon; 330 ohms ± 10%; 1 watt; 0.280" dia x 0.750" lg; 0.032" dia wire term. each end; tinned copper leads; JAN-R-11	1	CE 11941	39
JAN2D21	Tube: electron; miniature; 7 pin	4	CE 87077	51
JAN12AX7	Tube: electron; miniature; HI-MU twin triode; 9 pin; JAN-1-A	3	CE 87290	57
		2	CE 87077	51
		1	CE 87290	57
TS102P01	Socket, Tube: brass, pl; 7 pin tube	4	CE 11941	39
TS103P01	Socket, Tube: brass, pl; 9 pin tube	2	CE 11941	39
TS102U02	Shield: brass, pl	4	CE 87077	51
TS103U02	Shield: brass; pl	2	CE 87077	51
AN3057-4	Clamp, Cable: brass; pl	3	Sev	Sev
AN-3101A-12S-3S	Receptacle, Cable Type	1	CE 88066	56
		1	CE 87077	52
AN-3106A-12S-3P	Receptacle, Cable Type	1	CE 87422	40
CE 11004	Contact Assembly	127	Sev	Sev
CE 11011	Screw: stl; FH, csk, hex socket drive; #2-56 x 0.250" lg	14	CE 87067	50
CE 11012	Contact: FH; stl, pl	128	Sev	Sev
CE 11020	Contact Assembly	9	Sev	Sev
CE 11032	Spacer: round, flat; Vellumoid; 0.187" ID; 0.375" OD; 0.031" thk	*4	CE 87420	42
		2	CE 88000	57B
CE 11035	Rod: aluminum; 0.187" dia; 1.937" lg; tapped #4-40 x 0.312" deep both ends	*1	CE 87420	42
CE 11039	Spacer: Vellumoid; 2.000" lg x 1.625" w x 0.062" thk; 2 mtg holes 0.156" dia	*1	CE 87420	42
CE 11041	Terminal Block Assembly	1	CE 88000	57B
		*1	CE 87420	42
CE 11062	Wheel, Figured: CS	1	CE 87059	46
CE 11063	Ring: CS; 0.812" ID; 1.312" OD; 0.094" thk; tapped 3 places #4-40	1	CE 87059	46
CE 11064	Contact Assembly	115	CE 11941	39
CE 11085	Gear: Chrome molybdenum stl; 20 teeth; 0.187" ID (w/keyway); one end 0.458" OD, other end 0.359" OD; 0.531" loa	*1	CE 87419	42
CE 11093	Right Hand Plate and Contact Assembly	1	CE 87067	50
CE 11105	Right Hand Cover Assembly: aluminum	1	CE 87067	50
CE 11127	Left Hand Cover: aluminum	1	CE 87067	50
CE 11128	Right Hand End Plate Assembly	1	CE 87067	50
CE 11130	Gasket: rubber ring; 12.093" ID; 12.593" OD	1	CE 87069	53
		1	CE 87075	54
CE 11137	Shaft: SST; 6.437" lg	1	CE 87067	50
CE 11138	Ring, Retaining: cad. pl; 0.243" ID; 0.500" OD; 0.025" thk; Walde Kohinoor, Truarc "E" # X5133-31-S-MO	2	CE 87067	50
CE 11142	Leaf Assembly	19	CE 87011	48
CE 11149	Guard: aluminum; 1.342" lg; 1.125" w; 0.032" thk	1	CE 14462	41

\*Obsolete But Supplied.

(c) Item is classified CONFIDENTIAL  
~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 11163	Nut: round, brass, nickel pl; slotted; $\frac{5}{16}$ -32; 0.437" OD; 0.093" thk	29	CE 11371	40
CE 11167	Key Top—A	1	CE 11371	40
CE 11168	Key Top—B	1	CE 11371	40
CE 11170	Key Top—LET	1	CE 11371	40
CE 11171	Key Top—FIG	1	CE 11371	40
CE 11172	Key Top—RPT	1	CE 11371	40
CE 11173	Power Switch Assembly	1	CE 87311	40
CE 11180	Leaf	1	CE 11371	40
CE 11181	Leaf	1	CE 11371	40
CE 11183	Cleat: SST; 0.281" lg; 0.240" w; 0.093" thk; tapped # 4-40	2	CE 11371	40
CE 11184	Stiffener: beryllium copper; 0.010" thk	2	CE 11371	40
CE 11192	Leaf Assembly	7	CE 87011	48
CE 11195	Spring, Helical Extension: cyl; 15 coils; test 4 oz at 0.500"; 0.012" dia SST spring wire; 0.125" OD; 0.375" loa	1	CE 87330	41
CE 11201	Resistor, Adjustable: porcelain; 25 ohms $\pm$ 5%; 0.632 amp; 10 w; w/slide, screw and nut; 2 mtg tabs; Ohmite "Dividohm"	1	CE 87420	42
CE 11222	Plunger: nylon; 1.187" lg	7	CE 87068	49
CE 11223	Leaf Assembly	7	CE 87011	48
CE 11226	Leaf Assembly	7	CE 87011	48
CE 11227	Plate, Back-Up: SST; 1.062" lg; 0.025" thk	33	CE 87011	48
CE 11228	Spacer: laminated silicons resin, glass cloth base; 0.250" lg; 0.375" w; 0.046" thk	65	CE 87011	48
CE 11229	Plate: aluminum; 0.562" lg; 0.312" w; 0.064" thk	7	CE 87011	48
CE 11230	Bushing: cyl; laminated phenolic tubing, nylon fabric base; 0.125" ID; 0.187" OD; 0.600" lg	14	CE 87011	48
CE 11234	Housing Assembly	1	CE 11371	40
CE 11236	Radius Arm Assembly	1	CE 11371	40
CE 11237	Retainer: CRS; 1.406" lg; w/cam	1	CE 11371	40
CE 11238	Spring, Helical Compression: cyl; 13 coils; no test; 0.031" dia SST spring wire; 0.184" OD; 0.122" ID; 0.750" lg	1	CE 11371	40
CE 11239	Ball, Bearing: SST; type 440C; 0.188" dia	2	CE 11371	40
CE 11240	Ring, Retaining: external; stl, pl; 0.225" ID; 0.025" thk; Waldes Kohinoor Inc., # 5100-25-S-MO	1	CE 11371	40
CE 11241	Housing: SST	1	CE 87068	49
CE 11248	Nut, Hex: SST; $\frac{5}{16}$ -32; 0.093" thk; 0.625" w across flats	1	CE 11371	40
CE 11262	Plate: CS, pl; 4.312" lg; 0.500" w; 0.062" thk; 18 holes tapped # 4-40	1	CE 87011	48
CE 11266	Actuator: chrome stl, pl; one end slotted 0.025" x 0.562" deep	7	CE 87068	49
CE 11271	Key Top—C	1	CE 11371	40
CE 11277	Ring, Retaining: external; beryllium copper; 0.142" ID; 0.010" thk; Waldes Kohinoor Inc., # 5100-15-C	29	CE 11371	40
CE 11282	Contact Block Assembly	1	CE 87056	44
CE 11290-1	Spacer: round; CS; 0.188" ID; 0.312" OD; 0.114" thk; csk 0.031" dia x 45 degrees, both sides	1	CE 87058	41
	Note: Same spacer as above, with different thickness, as follows:			
	CE 11290-2 0.112" thk			
	CE 11290-3 0.110" thk			
	CE 11290-4 0.108" thk			
	CE 11290-5 0.106" thk			
	CE 11290-6 0.104" thk			
CE 11292	Pin: SST; 0.218" loa; 0.126" nominal dia; one end flanged, other end grooved	1	CE 87068	49
CE 11294	Crankshaft Assembly	1	CE 87059	46
CE 11299	Bearing, Ball: 0.500" OD; 0.1875" ID; 0.1662" thk, New Departure # R 3XR3E	1	CE 87058	41
		1	CE 87059	46

\*Obsolete But Supplied.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 11300	Shim: SST; 0.845" ID; 0.002" thk.....	as req	CE 87059	46
CE 11301	Rod: SST; 0.125" dia; 2.250" lg.....	1	CE 87068	49
CE 11302	Rod: SST; 0.125" dia; 1.875" lg.....	1	CE 87068	49
CE 11303	Ring, Retaining: external; beryllium copper; 0.215" ID; 0.015" thk; Waldes Kohinoor, Inc., # 5100-23-C.....	1	CE 87069	46
CE 11304	Contact Block Assembly.....	1	CE 87068	49
CE 11323	Follower Assembly.....	1	CE 11941	39
CE 11324	Follower: SST; 0.912" lg.....	1	CE 11323	39
CE 11326	Ring, Retaining: external; beryllium copper; 0.125" ID; 0.010" thk; Waldes Kohinoor Inc., # 5100-12-C.....	6	Sev	Sev
CE 11330	Lug and Cable Assembly.....	1	CE 11371	40
CE 11331	Spare Bar Assembly.....	1	CE 11371	40
CE 11340	Ring, Retaining: cad. pl; 0.094" ID; 0.230" OD; 0.015" thk; Waldes Kohinoor Truarc # 5133-12-S-MO.....	2	CE 87068	49
CE 11356	Key Top—D.....	1	CE 11371	40
CE 11362	Plate, Common: brass, pl; 7.531" lg; 0.062" w; 0.010" thk; 29 holes 0.328" dia, 1 hole 0.171" dia.....	1	CE 11371	40
CE 11363	Post, Common: brass, pl; Bind H; tapped # 4-40 x 0.312" deep, csk 82 degrees to 0.185" dia; body 0.185" dia x 0.708" lg; 0.770" loa.....	1	CE 11371	40
CE 11365	Screw: stl; Flat Fil H, hex socket drive; # 8-32 x 1.125" lg; gimlet point.....	5	CE 11371	40
CE 11366	Stand-Off: aluminum; 0.180" ID; 0.344" OD; 0.671" loa.....	5	CE 11941	39
CE 11370	Pin, Clevis: SST; Flat Fil H; 0.250" loa.....	2	CE 11371	40
CE 11371	Keyboard Assembly.....	1	CE 87077	51
CE 11372	Contact Block Assembly.....	1	CE 87068	41
CE 11376	Pawl Assembly.....	1	CE 87058	41
CE 11379	Stud: SST; Flat Fil H, slot drive; one shoulder 0.218" dia x 0.248" lg; one shoulder 0.146" dia x 0.105" lg, 0.031" eccentric; tip end 0.080" dia x 0.366" lg; 0.781" loa.....	1	CE 87058	41
CE 11383	Seal: felt; 0.171" ID; 0.437" OD; 0.125" thk.....	1	CE 87058	41
CE 11385	Spacer: SST; 0.185" ID; one end 0.375" OD x 0.155" lg, slotted; other end 0.236" OD x 0.240" lg; 0.395" loa.....	1	CE 87058	41
CE 11387	Ring, Retaining: external; beryllium copper; 0.168" ID; 0.015" thk; Waldes Kohinoor # 5100-18-C.....	2	CE 87058	41
CE 11388	Ring, Retaining: external; stl, pl; 0.550" ID; 0.035" thk; Waldes Kohinoor # 5100-59-S-MO.....	*1	CE 87419	42
CE 11389	Ring, Retaining: internal; stl, pl; 1.351" OD; 0.050" thk; Waldes Kohinoor # 5000-125-S-MO.....	1	CE 87058	41
CE 11390	Bearing, Ball: single row radial double seal; 0.5906" ID; 1.2598" OD; 0.3543" w; New Departure # 993L02X3E.....	1	CE 87058	41
CE 11393	Cover Assembly.....	1	CE 87059	47
CE 11394	Reel Drive Assembly.....	2	CE 87059	46
CE 11412	Screw: screw steel; Flat Fil H, hex socket drive; # 4-40 x 0.250" lg; 0.362" loa.....	10	Sev	Sev
CE 11440	Plug: cyl, aluminum alloy rod; 0.125" lg; 0.078" dia.....	1	CE 87056	44
CE 11441	Bushing: SST; 0.328" ID; 0.390" OD; 0.141" loa.....	1	CE 87056	44
CE 11442	Pivot: SST; one end thd 5/16-24 x 0.141" lg.....	1	CE 87056	44
CE 11445	Gear: SST; 63 teeth; ctr hole 0.280" sq; 1.354" OD; 0.287" thk loa.....	1	CE 87059	47
CE 11446	Gear: SST; 63 teeth; ctr hole 0.280" sq; 1.354" OD; 0.031" thk.....	1	CE 87059	47
CE 11449	Washer, Lock: SST; ctr hole 0.280" sq; 0.500" OD w/2 tap extensions 0.125" w; 0.031" thk.....	2	CE 87059	47
CE 11451	Leaf, Actuating.....	4	CE 11462	41

\*Obsolete But Supplied.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 11454	Leaf.....	4	CE 11462	41
CE 11457	Stop, Leaf: SST; 1.125" lg; 0.031" thk.....	8	CE 11462	41
CE 11458	Spacer: laminated silicons resin, glass cloth base; 0.625" lg; 0.313" w; 0.031" thk.....	12	CE 11462	41
CE 11459	Bushing: laminated phenolic nylon fabric base; 0.125" ID; 0.187" OD; 0.296" lg.....	8	CE 11462	41
CE 11460	Retainer: SST; 0.625" lg; 0.313" w; 0.094" thk; 2 mtg holes 0.125" dia, csk 82 degrees to 0.234" dia.....	4	CE 11462	41
CE 11461	Connector: copper, pl; 0.813" lg x 0.281" w x 0.013" thk.....	12	CE 11462	41
CE 11462	Switch Assembly (SPDT).....	4	CE 87058	41
CE 11463	Cam, Timing: nylon molding; 0.190" ID; 1.314" loa; 0.625" dia oa.....	1	CE 87058	41
CE 11464	Screw: CS, cad. pl; Hex H, 0.500" w across flats, no slot; #8-32 x 0.375" lg; 0.437" loa.....	2	CE 87059	47
CE 11476	Bushing: high leaded tin bronze; 0.313" ID; 0.375" OD; one end flanged 0.437" OD x 0.009" lg; other end grooved 0.037" deep x 0.031" w; 0.411" loa.....	1	CE 87059	47
CE 11480	Bushing: SST; 0.313" ID; 1.000" OD; 0.069" thk.....	1	CE 87059	46
CE 11486	Key Top—F.....	1	CE 11371	40
CE 11487	Key Top—G.....	1	CE 11371	40
CE 11488	Key Top—H.....	1	CE 11371	40
CE 11490	Key Top—J.....	1	CE 11371	40
CE 11491	Key Top—K.....	1	CE 11371	40
CE 11492	Key Top—L.....	1	CE 11371	40
CE 11493	Key Top—M.....	1	CE 11371	40
CE 11494	Key Top—N.....	1	CE 11371	40
CE 11499	Key Top—S.....	1	CE 11371	40
CE 11502	Key Top—V.....	1	CE 11371	40
CE 11504	Key Top—X.....	1	CE 11371	40
CE 11506	Key Top—Z.....	1	CE 11371	40
CE 11507	Key Top—O-1.....	1	CE 11371	40
CE 11508	Key Top—W-2.....	1	CE 11371	40
CE 11509	Key Top—E-3.....	1	CE 11371	40
CE 11510	Key Top—R-4.....	1	CE 11371	40
CE 11511	Key Top—T-5.....	1	CE 11371	40
CE 11512	Key Top—Y-6.....	1	CE 11371	40
CE 11513	Key Top—U-7.....	1	CE 11371	40
CE 11514	Key Top—I-8.....	1	CE 11371	40
CE 11515	Key Top—O-9.....	1	CE 11371	40
CE 11516	Key Top—P-β.....	1	CE 11371	40
CE 11519	Shaft: SST; 0.187" dia; tapped #4-40 x 0.375" both ends; 5.875" loa.....	1	CE 87068	49
CE 11520	Spring, Helical Compression: cyl; 5 coils; no test; 0.032" dia SST spring wire; 0.500" lg; 0.252" OD; 0.188" ID.....	1	CE 87058	41
CE 11525	Contact Block Assembly.....	2	CE 87068	49
CE 11526	Gear: SST; 93 external teeth and 72 internal teeth; 0.375" ID; 12 holes 0.156" dia thru side; 0.142" thk oa.....	2	CE 87059	47
CE 11531	Ribbon Reversing Mechanism Assembly.....	1	CE 87059	47
CE 11532	Ribbon Drive Gear Assembly.....	1	CE 87059	47
CE 11535	Ring, Retaining: external; spring steel, pl; 0.073" ID; 0.187" OD; 0.015" thk; Waldes Kohinoor #5133-9-S-MO.....	11	Sev	Sev
CE 11539	Coil Assembly.....	7	CE 87068	49
CE 11543	Plate: CS, pl; 0.781" lg; 0.250" w; 0.032" thk.....	7	CE 87068	49
CE 11548	Armature Assembly.....	7	CE 87068	49
CE 11549	Magnet Assembly.....	7	CE 87068	49
CE 11551	Screw: stl; FH, hex socket drive, csk; #4-40 x 0.781" lg.....	14	CE 87011	48
CE 11552	Nut, Hex: stl; #4-40; 0.093" thk; 0.250" w across flats.....	14	CE 11941	39
		8	CE 11462	41

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 11553	Setcrew: stl; headless, hex socket drive; #4-40 x 0.125" loa; cup point.....	14	CE 87068	49
CE 11554	Screw: stl; Flat Fil H, hex socket drive; #2-56 x 0.187" lg.....	4	CE 87077	51
CE 11555	Screw: stl; Flat Fil H, hex socket drive; #4-40 x 0.312" lg; 0.424" loa.....	7	Sev	Sev
CE 11556	Screw: stl; Flat Fil H, hex socket drive; #4-40 x 0.375" lg; 0.487" loa.....	24	Sev	Sev
CE 11561	Spring: beryllium copper; 4.312" lg; 1.437" w oa; 0.010" thk; 18 holes 0.125" dia.....	1	CE 87068	49
CE 11583	Base Assembly.....	7	CE 87068	49
CE 11584	Feed Roll Follower Assembly.....	1	CE 87059	46
CE 11599	Yoke Assembly.....	1	CE 87056	44
CE 11600	Stud: SST; hex body, 0.250" w across flats; one end thd #8-32 x 0.185" lg; other end 0.125" dia x 0.422" lg w/2 grooves 0.062" w; 0.812" loa.....	1	CE 87056	44
CE 11602	Washer, Flat: round; phosphor bronze; 0.125" ID; 0.250" OD; 0.016" thk.....	1	CE 87056	44
CE 11605	Eccentric: SST; 0.125" ID; 0.343" OD w/flat; shldr 0.234" OD, 0.023" eccentric; tapped 2 holes 90 degrees apart, #4-40.....	1	CE 87056	44
CE 11612	Lever: SST.....	1	CE 87056	44
CE 11613	Pawl: SST.....	1	CE 87056	44
CE 11614	Bracket Assembly.....	1	CE 87056	43-44
CE 11617	Spring, Helical Compression: cyl; 14 coils; no test; 0.020" dia SST spring wire; 0.625" lg; 0.181" OD; 0.141" ID.....	1	CE 87056	43
CE 11618	Plunger: SST; 1.093" lg.....	1	CE 87056	43
CE 11619	Lever: SST.....	1	CE 87056	43
CE 11620	Pivot: SST; Flat Fil H, slot drive; shldr 0.156" dia x 0.097" lg; thd #4-40 x 0.124" lg; 0.313" loa.....	1	CE 87056	43
CE 11621	Shaft: SST; thd one end #8-32 x 0.568" lg, slotted; 1.218" loa.....	1	CE 87056	43
CE 11624	Pawl: SST.....	1	CE 87056	43
CE 11625	Spacer: phosphor bronze; 0.188" ID; 0.500" OD; 0.040" thk.....	1	CE 87056	43
CE 11626	Spring, Helical Torsion: cyl; 4 coils; no test; 0.032" dia SST spring wire; 0.156" lg; 0.415" OD; 0.351" ID.....	1	CE 87059	46
CE 11629	Spring, Helical Extension: cyl; 10 coils; test 12 oz at 0.510"; 0.015" dia SST wire; 0.125" OD; 0.095" ID; 0.400" loa.....	1	CE 87056	44
CE 11630	Spring, Helical Compression: cyl; 12 coils; no test; 0.012" dia SST spring wire; 0.406" lg; 0.100" OD; 0.076" ID.....	1	CE 87056	44
CE 11631	Stud: SST; hex body, 0.250" w across flats x 0.110" lg; one end 0.124" dia x 0.353" lg w/groove and tip of 0.119" dia x 0.085" lg; other end threaded #8-32 x 0.265" lg; 0.813" loa.....	1	CE 87056	43
CE 11638	Pin: leaded bronze; one end 0.315" dia x 0.097" lg w/2 holes 0.063" dia 90 degrees apart thru side; 5 shoulders, 3 of them 0.025" eccentric; 0.456" loa.....	7	CE 87068	49
CE 11639	Pin: SST; 0.406" loa.....	7	CE 87068	49
CE 11646	Spring, Helical Torsion: cyl; 4 1/2 coils; no test; 0.032" dia SST spring wire; 0.218" lg; 0.281" ID; 0.531" loa.....	1	CE 87056	43
CE 11653	Ring, Retaining: external; CS; 0.051" ID; 0.156" OD; 0.010" thk; Waldes Kohinoor "E" #5133-6-S-PP.....	1	CE 87056	44
CE 11656	Link Assembly.....	1	CE 87059	46
CE 11657	Handle Assembly.....	1	CE 11371	40
CE 11663	Pawl: chromium steel, cad. pl.....	7	CE 87068	49
CE 11666	Spring, Helical Compression: cyl; 11 coils; no test; 0.017" dia SST spring wire; 0.397" lg; 0.120" OD; 0.085" ID.....	15	CE 87068	49
CE 11667	Spring, Helical Extension: cyl; 12 coils; test 18 oz at 0.625"; 0.014" dia SST spring wire; 0.208" lg; 0.125" OD; 0.097" ID; 0.394" loa.....	7	CE 87068	49

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
c CE 11669	Drive Linkage Assembly.....	7	CE 87068	49
CE 11671	Clip: CS, cad. pl; tapped 1 place #4-40, 1 place #2-56 and csk 82 degrees x 0.110" dia; 0.250" w; 0.500" lg; 0.062" thk.....	5	CE 87068	49
CE 11673	Spring, Helical Compression: cyl; 9 coils; no test; 0.016" dia SST spring wire; 0.500" lg; 0.180" OD; 0.148" ID.....	7	CE 87068	49
CE 11674	Spring, Helical Extension: cyl; 29 coils; test 5 oz at 0.875"; 0.016" dia SST spring wire; 0.470" lg; 0.187" OD; 0.155" ID; 0.642" loa.....	7	CE 87068	49
CE 11676	Sleeve: SST; 0.687" loa.....	7	CE 87068	49
CE 11678	Rod: SST; 0.093" dia; 1.515" lg.....	1	CE 87068	49
CE 11679	Rod: SST; 0.093" dia; 2.062" lg.....	1	CE 87068	49
CE 11680	Plate: aluminum; 4.307" lg; 0.656" w.....	1	CE 87068	49
CE 11681	Stud: SST; Flat Fil H, no slot; # 10-32 x 0.312" lg; 0.375" loa.....	7	CE 87068	49
CE 11683	Collar: aluminum; 0.187" ID; 0.375" OD; 0.250" lg; tapped thru side #4-40 to center.....	2	CE 87068	49
CE 11684	Key: SST.....	7	CE 87068	49
CE 11687	Screw: SST; round knurled head, hex socket drive, shldr 0.035" lg; unthreaded middle portion 0.140" dia x 0.625" lg; thd # 10-32 x 0.340" lg.....	4	CE 87059	46
CE 11688	Spacer: hollow cyl shape, one end closed; aluminum; 0.375" dia x 0.500" loa.....	1	CE 87058	41
CE 11689	Spring, Helical Extension: cyl; 35 coils; test 13 oz at 1.550"; 0.020" dia SST spring wire; 0.700" lg; 0.187" OD; 0.147" ID; 1.000" loa.....	2	CE 87069	53
CE 11691	Typewriter Ribbon: 3/16" w; medium ink; black-record.....	1	CE 87059	46
CE 11692	Metal Spool: spool minus ribbon; oxidized finish.....	2	CE 87077	52
CE 11693	Tape, Paper, Gummed: 0.375" w; 0.003" thk; white; gummed one side; 4.000" dia roll w/wooden core 0.750" OD and ctr hole 0.406" ID; each roll wrapped individually in moisture-proof wrapper; Mil Spec Mil-T-16188, Type C-10116.....	1	CE 87059	46
CE 11694	Spring, Helical Compression: cyl; 45 coils; no test; 0.025" dia SST spring wire; 1.125" lg; 0.187" OD; 0.137" ID.....	2	CE 87077	52
CE 11698	Spring, Helical Extension: cyl; 13 coils; test 7 1/2 oz at 0.125"; 0.014" dia SST spring wire; 0.182" lg; 0.125" OD; 0.097" ID; 0.562" loa.....	1	CE 87059	46
CE 11709	Clutch Drive Assembly.....	1	CE 87058	41
CE 11713	Screw: stl; Flat Fil H, hex socket drive; 0.375" dia x 0.250" lg; shldr 0.250" OD x 0.047" lg; unthreaded portion 0.185" dia x 0.703" lg; threaded 1/4-20 x 0.500" lg; 1.500" loa.....	10	CE 87046	55
CE 11723	Insert, Heli-Coil: SST; # 6-32 x 0.203" lg, notched; Heli-Coil Corp. #1185-06-CN.....	8	CE 87077	51
CE 11723	Insert, Heli-Coil: SST; # 6-32 x 0.203" lg, notched; Heli-Coil Corp. #1185-06-CN.....	1	CE 87056	43
CE 11723	Insert, Heli-Coil: SST; # 6-32 x 0.203" lg, notched; Heli-Coil Corp. #1185-06-CN.....	5	CE 87058	41
CE 11800	Transformer, Power, Step-Down: open frame; 100-125v, 200-250v; 50-60 cycle single phase; 305v ±5v at 4 amp rms; air cooled; 3 1/4" lg x 2 3/4" w x 3 1/2" h; 6 solder lug terminals; 4 mtg holes 3/16" dia; electrostatic shield between primary and secondary; Westinghouse Fosterite impregnated; Colin Campbell Co. No. L 1838.....	1	CE 88066	56

(C) Item is classified CONFIDENTIAL  
~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
*CE 11800	Transformer, Power, Step-Down: open frame; 100-124v, 200-250v; 50-60 cycle single phase; 30.5 v at 2.4 amp; air cooled; 3¼" lg x 2½" w x 3½" h; 6 solder lug terminals; 4 mtg holes ⅝" dia; electrostatic shield between primary and secondary; Westinghouse Fosterite impregnated.	1	CE 87066	56
CE 11802	Fuse Holder Assembly: Littlefuse #342001	2	CE 88066	56
CE 11813	Screw: stl; Flat Fil H, hex socket drive; #6-32 x 0.375" lg; 0.513" loa	2	CE 87058	41
CE 11814	Screw: stl; FH, csk, hex socket drive; #2-56 x 0.125" lg	2	CE 87068	49
CE 11816	Screw: stl; FH, csk, hex socket drive; #4-40 x 0.250" lg	5	CE 87068	49
CE 11818	Screw: stl; FH, csk, hex socket drive; #4-40 x 0.375" lg	27	Sev	Sev
CE 11818	Screw: stl; FH, csk, hex socket drive; #4-40 x 0.375" lg	6	CE 87068	49
CE 11819	Nut, Hex: stl; ⅝-18; 0.203" thk; 0.594" w across flats	2	CE 88066	56
CE 11819	Nut, Hex: stl; ⅝-18; 0.203" thk; 0.594" w across flats	2	CE 88066	55
CE 11820	Setscrow: stl; headless, hex socket drive; oval point; #8-32 x 0.250" lg	2	CE 11871	40
CE 11820	Setscrow: stl; headless, hex socket drive; oval point; #8-32 x 0.250" lg	8	CE 87068	49
CE 11821	Nut, Hex: stl; #6-32; 0.093" thk; 0.250" w across flats	8	Sev	Sev
CE 11822	Washer, Flat: round; stl; 0.328" ID; 0.750" OD; 0.063" thk	2	CE 88066	56
CE 11823	Washer, Flat: round; stl; 0.120" ID; 0.343" OD; 0.031" thk	4	CE 11941	39
CE 11823	Washer, Flat: round; stl; 0.120" ID; 0.343" OD; 0.031" thk	2	CE 87068	49
CE 11825	Washer, Lock: round, slit helical ring; CS; 0.141" ID; 0.251" OD; 0.031" thk	38	Sev	Sev
CE 11826	Washer, Lock: round, slit helical ring; CS; 0.115" ID; 0.212" OD; 0.025" thk	56	Sev	Sev
CE 11828	Washer, Lock: round, slit helical ring; CS; 0.319" ID; 0.575" OD; 0.056" thk	2	CE 87066	56
CE 11830	Washer, Lock: round, slit helical ring; CS; 0.168" ID; 0.296" OD; 0.040" thk	25	Sev	Sev
CE 11832	Screw: stl; Flat Fil H, hex socket drive; #6-32 x 0.312" lg; 0.450" loa	2	CE 87056	45
CE 11833	Screw: stl; Flat Fil H, hex socket drive; #6-32 x 0.312" lg; 0.450" loa	1	CE 87056	43
CE 11833	Screw: stl; Flat Fil H, hex socket drive; #8-32 x 0.375" lg; 0.539" loa	1	CE 87056	46
CE 11833	Screw: stl; Flat Fil H, hex socket drive; #8-32 x 0.375" lg; 0.539" loa	1	CE 87422	57A
CE 11833	Screw: stl; Flat Fil H, hex socket drive; #4-40 x 0.437" lg; 0.546" loa	4	CE 88066	56
CE 11833	Screw: stl; Flat Fil H, hex socket drive; #4-40 x 0.437" lg; 0.546" loa	4	CE 87422	57A
CE 11839	Setscrow: stl; headless, hex socket drive; cup point; #4-40 x 0.187" lg	1	CE 87058	41
CE 11840	Screw: stl; Flat Fil H, hex socket drive; #6-32 x 0.437" lg; 0.575" loa	8	CE 87077	51
CE 11841	Screw: stl; Flat Fil H, hex socket drive; #6-32 x 0.500" lg; 0.638" loa	3	CE 87058	41
CE 11841	Screw: stl; Flat Fil H, hex socket drive; #6-32 x 0.500" lg; 0.638" loa	2	CE 87077	51
CE 11842	Screw: stl; Flat Fil H, hex socket drive; #8-32 x 0.500" lg; 0.664" loa	12	CE 87059	46
CE 11844	Screw: stl; Flat Fil H, hex socket drive; #6-32 x 0.625" lg; 0.763" loa	1	CE 87059	46
CE 11844	Screw: stl; Flat Fil H, hex socket drive; #6-32 x 0.625" lg; 0.763" loa	4	CE 87077	51
CE 11846	Screw: stl; FH, csk, hex socket drive; #6-32 x 0.375" lg	4	CE 87059	46
CE 11847	Nut, Hex, Acorn: SST; #8-32; 0.310" high; 0.312" w across flats	1	CE 87059	46
CE 11848	Washer, Lock: round, slit helical ring; CS; ¼" ID; 0.500" OD; 0.062" thk	10	CE 87046	55
CE 11848	Washer, Lock: round, slit helical ring; CS; ¼" ID; 0.500" OD; 0.062" thk	8	CE 87077	51
CE 11851	Setscrow: stl; headless, hex socket drive; cup point; #4-40 x 0.156" lg	2	CE 87056	43
CE 11851	Setscrow: stl; headless, hex socket drive; cup point; #4-40 x 0.156" lg	2	CE 87056	44
CE 11855	Screw: stl; Flat Fil H, hex socket drive; #6-32 x 0.250" lg; 0.388" loa	5	Sev	Sev
CE 11859	Positioning Arm: chromic steel, cad. pl	1	CE 87068	49
CE 11860	Rivet: aluminum; FH, csk; 0.062" dia x 0.125" lg	6	CE 87067	50

\*Obsolete But Supplied.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 11912	Feed Roll: aluminum; ctr hole 0.214" sq; 0.985" OD; 260 teeth.....	1	CE 87056	44
CE 11916	Shaft: SST; 1.750" loa; one end thd # 6-32 x 0.141" lg.....	1	CE 87056	44
CE 11933	Power Cord Assembly.....	1	CE 88066	56
CE 11941	Contact Panel Assembly.....	1	CE 87077	39-51
CE 11942	Strap: CS, cad. pl; 1.874" loa; 0.250" w; 0.028" thk.....	1	CE 11941	39
CE 11945	Spring Assembly.....	1	CE 87059	46
CE 11946	Stop: cyl; aluminum; 1.000" lg; 0.125" dia.....	1	CE 87059	46
CE 11947	Clevis: CS, cad. pl.....	1	CE 87059	46
CE 11948	Clevis: CS, cad. pl.....	1	CE 87059	46
CE 11949	Pin, Clevis: CS; Flat Fil H; 0.281" loa.....	2	CE 87059	46
CE 11950	Diode: Germanium; type CD-6; Radio Receptor Co., Inc.....	20	CE 11941	39
CE 11956	Cover and Insulator Assembly.....	1	CE 87420	42
CE 11962	Plate: SST; 1.108" w; 0.062" thk; 1 hole 0.516" dia; 2 holes 0.144" dia.....	2	CE 87066	56
CE 11966	Switch Plate: aluminum; 2.375" lg; 1.781" w; 0.312" thk; tapped 4 mtg holes # 4-40.....	1	CE 87066	56
CE 11969	Nut, Hex: SST; 3/16-18; hex portion 0.563" w across flats; middle portion round, 0.875" OD x 0.062" lg; one end 0.495" OD x 0.268" lg; 0.562" loa; special.....	2	CE 87066	56
CE 11970	Rectifier, Selenium: full-wave, bridge; 33v AC; 26.4v ±5% DC; 3.05 amps DC; Fansteel # EE 1022 T finish.....	2	CE 87066	56
*CE 11970	Rectifier, Selenium: full-wave, bridge; 33v AC; 25.3-27.9v DC; 2.4 amps DC; mtg both ends, thd 3/16-18; 4.750" loa; 2.625" dia; Fansteel # EE1000 T finish.....	2	CE 87066	56
CE 11971	Contact Board Assembly.....	1	CE 88066	56
CE 11974	Thumbscrew: SST; head 0.572" lg x 0.500" w, flat sides; thd # 10-32 x 0.305" lg; flat tip, unthreaded; 0.118" dia w/groove; 1.000" loa; special.....	1	CE 87066	56
CE 11976	Thumbscrew: SST; head 0.563" lg x 0.625" w; thd 1/4-20 x 0.281" lg w/gimlet point; 1.500" loa.....	4	CE 87066	56
CE 11980	Carrier: aluminum.....	1	CE 11981	55
CE 11981	Carrier Assembly.....	1	CE 87075	55
CE 11985	Capacitor: cyl; metalized paper; 2.0 ±0.2 uf; 200v DC working voltage; 1.625" lg; 0.593" dia.....	2	CE 11941	39
CE 11987	Capacitor: cyl; metalized paper; 0.25 ±0.025 uf; 200v DC working voltage; 0.688" lg; 0.438" dia.....	2	CE 11941	39
CE 11988	Capacitor, Fixed Ceramic: round disk; 0.0001 ±0.001 uf; 500v DC working voltage; 0.593" dia; 0.093" thk.....	2	CE 11941	39
CE 11989	Capacitor, Fixed, Ceramic: round disk; 0.002 ±0.0002 uf; 500v DC working voltage; 0.593" dia; 0.093" thk.....	1	CE 11941	39
CE 11990	Capacitor, Fixed, Ceramic: round disk; 0.005 ±0.001 uf; 500v DC working voltage; 0.563" dia; 0.093" thk.....	2	CE 11941	39
CE 11991	Capacitor, Fixed, Ceramic: round disk; 0.01 (plus 80%, minus 20%) uf; 600v DC working voltage; 0.563" dia; 0.093" thk.....	4	CE 11941	39
CE 11993	Clip: CS, cad. pl; 1.062" loa.....	2	CE 11941	39
CE 11995	Bracket: SST.....	1	CE 14462	41
CE 14310	Pin, Hinge: SST; 3.750" lg; 0.078" dia.....	1	CE 87069	53
CE 14316	Bushing: Heyco Strain Relief Bushing Type SR-Sp.....	1	CE 11371	40
		2	CE 88066	56
CE 14318-3	Cable: rubber insulated; two # 18 conductor; 1/4" dia; 27 1/2" lg.....	1	CE 87066	56
CE 14440	Washer, Lock: round, slit helical ring; CS; # 10 ID.....	10	Sev	Sev
CE 14441	Nut, Hex: stl; # 8-32; 0.125" thk; 0.312" w across flats.....	1	CE 87056	43
CE 14447	Hinge, Base: SST; 6.188" lg.....	1	CE 87046	55
CE 14449	Block: SST; tapped # 10-32; slotted 0.187" w.....	2	CE 87068	49

\*Obsolete But Supplied.

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 14590	Ring, Retaining: external; carbon spring steel; 0.500" ID; Waldes Kohinoor Inc. Truarc #5100-50-SPP-----	2	CE 87066	56
CE 14591	Bridge: phenolic molding-----	1	CE 87066	56
CE 14592	Fuse: Type 3AG; 2 amp, 250v; Littlefuse #312002-----	2	CE 87066	56
CE 14595	Bearing, Ball: 0.748" OD; 0.2362" ID; 0.2362" thk; New Departure double seal #99036X1292E-----	1	CE 87058	41
		2	CE 87068	49
CE 14600	Nut, Hex: SST; #10-32; 0.187" thk; 0.375" w across flats-----	1	CE 87059	47
CE 14605	Ring, Stationary: black phenolic-----	1	CE 87067	50
CE 14606	Washer, Flat: round; SST; 0.070" ID; 0.187" OD; 0.018" thk-----	4	CE 87074	54
CE 14614	Screw, Drive: stl, cad. pl; RH; 0.058" dia; 0.125" lg; Parker-Kalon-----	4	CE 87066	55
		4	CE 87066	56
CE 14618	Screw: stl; Flat Fil H, hex socket drive; #8-32 x 0.250" lg-----	1	CE 88001	57B
CE 14643	Cable Assembly-----	1	CE 87077	52
CE 14649	Detent Assembly-----	2	CE 87046	55
CE 14652	Stud: SST; one end 0.625" OD x 0.187" lg; other end thd 1/8-14 x 0.133" lg; middle portion undercut 0.343" dia x 0.100" lg; center tapped 1/4-20; 0.420" loa-----	5	CE 87046	55
CE 14653	Stud: SST; one end thd 1/8-14 x 0.134" lg, w/undercut 0.343" dia x 0.100" lg; other end tapered 0.372" OD to 0.812" OD; middle portion 0.625" OD x 0.187" lg; center tapped 1/4-20 (double thread); 0.609" loa-----	2	CE 87046	55
CE 14654	Housing: SST; Hex H, ctr drilled 0.125" ID x 0.181" deep; other end ctr drilled 0.203" ID x 0.860" deep, thd outside 1/4-16 x 0.750" lg; 1.031" loa-----	2	CE 87046	55
		2	CE 87046	55
CE 14655	Detent: SST-----	2	CE 87046	55
CE 14656	Spring, Helical Compression: eyl; 11 coils; no test; 0.022" dia SST spring wire; 0.187" OD; 0.143" ID; 0.760" lg--	2	CE 87046	55
CE 14657	Screw: stl; FH, csk, hex socket drive; #10-32 x 0.375" lg--	3	CE 87046	55
CE 14663	Cover: aluminum; 8.780" lg; 8.218" w; 0.040" thk-----	1	CE 87072	55
CE 14664	Screw: SST; Hex H, 0.250" w across flats; shldr 0.166" dia x 0.060" lg; #4-40 x 0.103" lg; special-----	2	CE 87072	55
CE 14669	Screw: stl; Flat Fil H, hex socket drive; #10-32 x 0.500" lg; 0.690" loa-----	3	CE 87046	55
CE 14683	Screw: stl; Flat Fil H, hex socket drive; #4-40 x 0.187" lg; 0.299" loa-----	4	CE 11941	39
CE 14731	Operating Light Assembly-----	1	CE 87077	51
CE 14732	Hood Assembly-----	1	CE 87077	51
CE 14737	Lens: round; HN-32 polarizer; 1.198" dia; 0.030" thk-----	1	CE 87077	51
CE 14739	Lens: round; HN-32 polarizer; 1.250" dia; 0.030" thk-----	1	CE 87077	51
CE 14740	Ring, Retaining: SST; 1.130" ID; 1.250" OD; 0.035" thk; split; feather edge-----	1	CE 87077	51
CE 14741	Bezel: SST; light diamond knurl-----	1	CE 87077	51
CE 14742	Spring: blue tempered spring steel, 4 waves; 3.750" lg; 0.125" w; 0.006" thk material-----	1	CE 87077	51
CE 14743	Gooseneck Assembly-----	1	CE 87077	51
CE 14755	Adapter: SST; one end diamond knurl, tapped 1/4-24 x 0.375" deep; 1.125" loa-----	1	CE 87077	51
CE 14756	Spring: blue tempered spring steel; 1.000" loa; 0.125" h; 0.006" thk-----	2	CE 87077	51
CE 14760	Lamp: 28v; 0.17 amp; T3-1/4 bulb; miniature bayonet base; #313 Gen. Elec. Co-----	1	CE 87077	51
		1	CE 87290	57
CE 14766	Lug, Midget Turret: brass, silver pl; 0.474" lg-----	89	CE 11941	39
		5	CE 87066	56
CE 14768	Washer, Lock: internal teeth; stl; 0.508" ID; 0.625" OD; 0.022" thk; Shakeproof #1224-04-----	1	CE 11941	39
CE 14598	CRAC ASSEMBLY OFFICE	1	CE 87077	51

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 14771	Washer, Flat: round; stl; 0.130" ID; 0.250" OD; 0.031" thk	14	CE 11941	39
		*2	CE 87420	42
CE 14798	Socket Assembly	1	CE 11941	39
CE 14799	Nut, Hex: CRS; 3/8-32; 0.093" thk; 0.562" w across flats	1	CE 11941	39
CE 54500	Washer, Flat: round; CS; 0.188" ID; 0.375" OD; 0.025" thk	2	CE 87059	46
*CE 54511	Armature Assembly: Input-24v DC, 1 amp; Output-single phase, 6600 rpm, 440 cycles, 200v peak, 0.015 Int. H.P. Mech., Bendix RC-5409-1E	1	CE 87419	42
*CE 54512	Yoke and Field Coll: Bendix RC 5418-1-F	1	CE 87419	42
*CE 54513	Screw: stl; FH, csk, hex socket drive; #4-40 x 0.250" lg (loa)	2	CE 87419	42
*CE 54514	Head Assembly: Bendix RB-5414-1A	1	CE 87419	42
*CE 54515	Stator and Flange Head Assembly: Bendix RCS-5424-1	1	CE 87419	42
*CE 54516	Grommet, Rubber: round, 0.609" OD; 0.297" ID; H.O. Canfield Co. #8677 rubber	1	CE 87419	42
*CE 54517	Ball, Bearing: 0.197" ID x 0.748" OD x 0.236" thk, Bendix RC-214 AB-11, or New Departure No. 77035 x 1254E	1	CE 87419	42
*CE 54518	Bearing, Ball: 0.286" ID; 0.748" OD; 0.406" thk; Bendix #RC-214 AB-6, or New Departure No. 87036T1254E	1	CE 87419	42
*CE 54519	Cover, End: stl; Bendix No. RB-5610-1	1	CE 87419	42
*CE 54520	Clamp, Lead: cad. pl; 0.812" lg; 0.312" w; 0.031" thk material; 1 mtg hole 0.172" diameter; Bendix No. RBS-5698-1	1	CE 87419	42
*CE 54521	Screw: stl; Flat Fil H, hex socket drive; #8-32 x 0.187" lg; 0.351" loa; Bendix #RB-317-1	1	CE 87419	42
*CE 54522	Positive Brush, Assembly	1	CE 87419	42
*CE 54523	Negative Brush, Assembly	1	CE 87419	42
CE 54526	Pin: cyl; CS; 0.094" dia; 0.218" lg	6	CE 87068	49
CE 54528	Latch, Left Hand: CS, cad. pl	1	CE 87068	49
CE 54529	Latch, Right Hand: CS, cad. pl	1	CE 87068	49
CE 54530	Support, Left Hand: CS; 1.500" lg; 1.125" w; 0.218" thk	1	CE 87068	49
CE 54531	Support, Right Hand: CS; 1.500" lg; 1.125" w; 0.218" thk	1	CE 87068	49
CE 54532	Left Hand Latch Assembly	1	CE 87068	49
		1	CE 11981	55
CE 54533	Right Hand Latch Assembly	1	CE 87068	49
		1	CE 11981	55
CE 54534	Nut, Hex: SST; 3/8-32; 0.500" w across flats; one side tapered shldr 0.420" OD x 0.063" lg, csk; other side shldr 0.500" OD x 0.015" lg, csk; 0.219" thk	1	CE 87056	43
CE 54542	Ratchet and Bushing Assembly	1	CE 87056	43-44
CE 54543	Double Drive Ratchet Assembly	1	CE 87056	43-44
CE 54544	Spring, Helical Extension: cyl; 80 coils; test 3 3/4 oz at 1.550"; 0.010" dia SST wire; 0.093" OD; 0.073" ID; 1.000" loa	1	CE 87058	41
		2	CE 87056	44
CE 54549	Right Front Dust Cover Assembly	1	CE 87059	47
CE 54550	Right Rear Dust Cover Assembly	1	CE 87059	47
CE 54551	Left Front Dust Cover Assembly	1	CE 87059	47
CE 54552	Left Rear Dust Cover Assembly	1	CE 87059	47
CE 54568	Washer, Lock: internal teeth; stl; 0.520" ID; 0.781" OD; 0.010" thk; Shakeproof #1224-08	1	CE 11371	40
		2	CE 87066	56
CE 54571	Drive Ratchet Assembly	1	CE 87056	43-44
CE 54572	Screw Assembly	2	CE 87068	49
CE 54579	Pawl: SST	1	CE 87066	44
CE 54580	Pawl: SST	1	CE 87066	44
CE 54582	Key Switch Assembly	28	CE 11371	40

\*Obsolete But Supplied.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 54588	Key Switch Assembly	1	CE 11371	40
CE 54584	Pin: SST; 0.125" dia; 0.320" loa	1	CE 87068	49
CE 54589	Damper: beryllium copper; 1.187" lg; 0.281" w; 0.010" thk.	8	CE 11462	41
CE 54590	Damper: beryllium copper; 1.187" lg; 0.281" w; 0.010" thk.	4	CE 11462	41
CE 54591	Washer, Brake: round; phosphor bronze; 0.570" ID, w/ flats; 0.687" OD; 0.062" thk; one side chamfered, 1 side flat	2	CE 87059	47
CE 54592	Spring, Helical Compression: cyl; 4 coils; test 10 oz at 0.281"; 0.030" dia SST wire; 0.875" lg; 0.640" OD; 0.580" ID	2	CE 87059	47
CE 54594	Screw: stl; Flat Fil H, hex socket drive; # 4-40 x 0.343" lg; 0.455" loa	14	CE 87068	49
*CE 54597	Plate	1	CE 87419	42
*CE 54598	Screw: stl; FH, csk, hex socket drive; # 10-32 x 3.000" lg (loa); Bendix No. RB-144-5	2	CE 87419	42
*CE 87000	Insulating Board and Clip Assembly	1	CE 87420	42
*CE 87002	Resistor, Fixed: cyl; 0.377" dia x 1.438" lg; copper coated ends; 30 ohms ±10% at 25 degrees Centigrade; 1.438" lg; 0.377" dia; Carborundum Co., Global Div. Type F, #342F-1	1	CE 87420	42
*CE 87003	Panel: aluminum; 4.260" lg; 1.937" w; 0.031" thk material	1	CE 87420	42
CE 87008	Leaf	4	CE 11462	41
CE 87011	Switch Assembly	1	CE 87068	49
CE 87014	Pin, Shoulder: SST; one end 0.157" dia x 0.171" lg; other end 0.090" dia x 0.173" lg, w/groove; 0.344" loa	1	CE 87059	46
CE 87015	Collar, Eccentric: SST; 0.090" ID; 0.250" OD, 4 equally spaced slots in periphery; shldr 0.160" OD x 0.035" lg; 0.012" eccentric; 0.094" loa	1	CE 87059	46
CE 87019	Print Magnet Assembly	1	CE 87059	46
CE 87021	Insert: black rubber; 0.416" lg; 0.205" w; 0.150" thk	2	CE 87068	49
CE 87022	Support: CS, cad. pl; 1.500" lg; 0.750" w; 0.218" thk	2	CE 87068	49
CE 87023	Clip, Cable: black nylon	4	CE 11941	39
CE 87027	Bracket, Left Hand: aluminum	1	CE 87077	51
CE 87028	Support: aluminum	2	CE 87077	51
CE 87029	Hub: aluminum; 0.187" ID, w/key; 1.312" OD; 0.350" thk	1	CE 87059	46
CE 87038	Support: aluminum	1	CE 87056	45
CE 87039	Plate: aluminum; 1.437" lg; tapped 8 places # 4-40; tapped 2 places # 6-32	1	CE 87058	41
CE 87041	Base: aluminum	1	CE 87058	56
CE 87043	Drawer: aluminum	1	CE 87072	55
CE 87044	Bracket, Left Hand: aluminum	1	CE 87046	55
CE 87045	Bracket, Right: aluminum	1	CE 87046	55
CE 87046	Base Assembly	1	CE 87075	55
CE 87047	Housing Assembly	1	CE 87059	46
CE 87048	Right Hand Bracket Assembly	1	CE 87077	51
CE 87049	Base Assembly: (KLB-7/TSEC)	1	CE 87077	51
CE 87056	Pulse Generator Assembly	1	CE 87059	46
CE 87058	Timing Unit Assembly	1	CE 87059	46
CE 87059	Printer Assembly	1	CE 87077	Sev
CE 87061	Housing Assembly	1	CE 87058	41
CE 87062	Cam Switch and Trip Magnet Assembly	1	CE 87058	41
CE 87063	Shell Assembly	1	CE 87067	50
*CE 87066	AC Power Converter Assembly	1	CE 87075	56
(c) CE 87067	Cipher Unit Assembly: (not furnished—order component parts)	1	CE 87077	50-51
CE 87054	Carrying case assembly	1	CE 87075	55
			MAIN	53

\*Obsolete But Supplied.

(c) Item is classified CONFIDENTIAL

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
(c) CE 87068	Stepping Unit Assembly: (not furnished-order component parts)	1	CE 87077	49-51
CE 87069	Cover Assembly	1	Main CE 87054	53
CE 87070	Case Assembly	1	Main CE 87054	53
CE 87072	Drawer Assembly	1	CE 87075	55
CE 87074	Cover Assembly	1	CE 87075	54
CE 87075	Accessories and Case Assembly	1	Main	54
CE 87076	Case Assembly	1	CE 87075	54
(c) CE 87077	TSEC/KL-7 Cipher Machine: (not furnished-order component parts)	1	Main	52
CE 87095	Cover Assembly	1	CE 87068	49
CE 87098	Washer, Retaining: spring steel; special	2	CE 87059	46
CE 87130	Copy Holder Assembly	1	CE 87069	53
CE 87142	Seal: round, cyl; black rubber; 0.250" ID; 0.500" OD; 0.125" thk	2	CE 87069	53
CE 87146	Fastener: CS, cad. pl.	2	CE 87069	53
CE 87148	Ring, Retaining: 0.220" ID; 0.380" OD; 0.025" thk; Waldes Kohinoor, Truarc # 5103-25	2	CE 87069	53
CE 87157	Window: transparent; 4.500" lg; 0.985" w; 0.030" thk	1	CE 87067	50
CE 87158	Frame, Window: brass	1	CE 87067	50
CE 87161	Spring, Helical Compression: cyl; 3 coils; no test; 0.044" dia SST spring wire; 0.875" lg; 0.750" OD; 0.662" ID	2	CE 87069	53
CE 87162	Washer, Spring Retaining: aluminum	2	CE 87069	53
CE 87165	Ribbon Cover Assembly	1	CE 87059	47
CE 87171	Key: CS; 0.062" sq; 0.281" lg	1	CE 87419	42
CE 87173	Gear and Pinion Assembly	1	CE 87056	45
CE 87198	Rivet: aluminum, black anodized; oval head; 0.094" dia; 0.125" lg; 0.156" loa	6	CE 87067	50
CE 87229	Spring, Helical Extension: cyl; 20 coils; test 1 lb. 2 oz at 0.875"; 0.022" dia SST wire; 0.155" OD; 0.111" ID	4	CE 87290	57
CE 87230	Washer, Flat: round; CS; 0.115" ID; 0.174" OD; 0.025" thk	2	CE 87059	47
CE 87231	Eccentric: SST; 0.188" ID; 0.500" OD, w/flat 0.468" OD; shldr 0.312" dia, 0.046" eccentric; larger dia tapped # 4-40, through, 2 holes 90 degrees apart	1	CE 11371	40
CE 87232	Pawl Assembly	1	CE 87056	43
CE 87233	Dust Cover, Front: black rubber; 2.740" loa; 0.312" w	1	CE 87059	47
CE 87234	Washer, Flat: round; stl; 0.203" ID; 0.438" OD; 0.031" thk	2*	CE 87059	47
CE 87239	Capacitor: cylindrical; metallized paper; 0.03 ±0.003 uf, 400v DC working voltage; 0.688" lg; 0.438" dia	1	CE 11941	39
CE 87244	Frame Assembly	1	CE 87068	49
CE 87252	Frame Assembly	1	CE 14462	41
CE 87256	Grommet, Key Button: rubber; 0.530" ID; 0.732" OD; 0.422" h; one end closed, w/elongated slot	29	CE 11371	40
CE 87261	Plug, Storage: aluminum casting	1	CE 87077	51
(c) CE 87264	Left Hand Plate and Contact Assembly	1	CE 87067	50
CE 87265	Key Chassis and Rail Assembly	1	CE 11371	40
CE 87267	Contact Assembly	1	CE 11941	39
<del>CE 87272</del>	<del>Seal, Space Bar: black sponge rubber; 0.750" lg x 0.562" w x 0.100" thk</del>	<del>4</del>	<del>CE 11941</del>	<del>40</del>
CE 87273	Tube Puller: 9 pin; approx 3/4" lg; Kellums # 13-16	1	CE 87290	57
CE 87274	Tube Puller: 7 pin; approx 2 1/2" lg; Kellums # 11-16	1	CE 87290	57
CE 87275	Kit, Vehicle Mounting: See Appendix C			
CE 87278	Ring, Retaining: SST; 1.089" ID; 1.124" OD; 0.036" thk; split ring	1	CE 87077	51

(c) Item is classified Confidential

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 87279	Capacitor: cylindrical; molded tubular paper; 0.05 ±10% uf; 400v DC working voltage; 1.250" lg; 0.500" dia.....	1	CE 11941	39 ✓
CE 87281	Bushing: phosphor bronze; 0.187" ID; one end 0.375" OD x 0.250" lg, other end thd 1/8-32 x 0.170" lg; middle portion 0.314" OD x 0.175" lg w/relieved portion 0.270" OD x 0.050" lg; 0.645" loa.....	1	CE 87056	43
CE 87287	Washer, Flat: round; blue tempered spring steel; 0.190" ID; 0.568" OD; 0.006" thk.....	58	CE 11371	40
CE 87290	Operator Kit Assembly.....	1		57
CE 87291	Brush: nylon; round sash brush; rubber set; 2 3/4" bristle, 1/2" dia; 4 1/4" loa.....	1	CE 87290	57
CE 87292	Brush: toothbrush type; 6" lg x 1/2" w.....	1	CE 87290	57
CE 87293	Cleaning Block Assembly.....	1	CE 87290	57
CE 87294	Tape Moistener: Teletype # 70169.....	1	CE 87290	57
CE 87295	Tape Cutter: 3/4" thimble; Teletype # 105174.....	1	CE 87290	57
CE 87296	Eraser: A.W. Faber-Castell 701; 2 1/2" lg x 3/4" w x 1/16 thk.....	1	CE 87290	57
CE 87297	Lubricant, "Quietone": 1/2 pint round cone top can w/ screw cap and brush.....	1	CE 87290	57
CE 87298	Cloth, Twilljean: 20 pcs 9" x 9".....	1	CE 87290	57
CE 87299	Strap: web; fine weave; 5 1/2" lg x 1 1/2" w.....	2	CE 87290	57
CE 87318	Shade, Operating Light: DuPont black nylon.....	1	CE 87077	51
CE 87330	Clutch and Timing Shaft Assembly.....	1	CE 87058	41
CE 87347	Stud: CS, cad. pl; Fil H, not slotted, 0.062" dia x 0.145" lg; 0.176" loa.....	4	CE 87077	51
CE 87374	Screw: stl; FH, csk, hex socket drive; #6-32 x 0.625" loa.....	1	CE 87077	51
CE 87375	Shaft: SST; 6.820" lg.....	1	CE 87068	49
CE 87376	Bearing, Ball: SST; 0.0937" ID; 0.3125" OD; 0.1094" w.....	7	CE 87068	49
CE 87377	Setscrew: stl, cad. pl; headless, hex socket drive; cup point; #4-40 x 0.312" lg.....	2	CE 87068	49
CE 87378	Shaft, Bearing: cyl; SST; 1.943" lg; 0.098" dia.....	1	CE 87068	49
CE 87379	Shaft, Bearing: SST; 1.390" lg; 0.093" dia.....	1	CE 87068	49
CE 87380	Shaft Assembly.....	1	CE 87068	49
CE 87382	Spacer: laminated silicons resin, glass cloth base; 0.625" lg; 0.313" w; 0.062" thk.....	4	CE 11462	41
CE 87388	Stator and Endbell Assembly.....	1	CE 87056	45
CE 87409	Washer, Flat: round; corrosion resisting stl; 0.265" ID; 0.500" OD; 0.032" thk.....	10	CE 87046	55
CE 87415	Rivet: aluminum, FH, csk, 0.125" dia x 0.125" loa.....	8	CE 87077	51
CE 87417	Shaft: SST.....	4	CE 87063	50
*CE 87419	Motor Generator Assembly.....	1	CE 87056	44
*CE 87420	Motor Generator and Controller Assembly.....	1	CE 87420	42
CE 87422	Filter, Radio Interference: 2 inductances, 300 microhenries each; 4 capacitors, 0.5 microfarad each; current rating 3 amps at 31v DC; 4.060" h, 1.938" lg; 1.170" w; screw mounted; 4 1/4" holes.....	1	CE 87059	46
CE 87423	Container and Cover Assembly: for one stepping unit and for one cipher unit; 1/2" Royalite #2882 grey, colonial grain random core.....	1	CE 87048	57A
CE 87433	Container, Printer Storage: for one printer, permanent shipping container, material 1/2" Royalite #2882, grey colonial grain, random core.....	1	Main	NI
CE 87444	Washer, Lock: internal tooth; round; stl, cad. pl; black dip; 0.120" ID; 0.260" OD; 0.016" thk; Shakeproof #1204-00.....	1	Main	NI
CE 87446	Screw: stl, cad. pl; cone shaped head, hex socket drive; #6-32 x 0.250" lg; 0.388" loa.....	4	CE 87422	57A
		1	CE 87058	41

\*Obsolete But Supplied.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 87447	Screw: stl, cad. pl; cone shaped head, hex socket drive; # 8-32 x 0.500" lg; 0.638" loa	1	CE 87058	41
CE 87453	Canopy: lucite, black; 1.282" h; 0.875" OD; knurled base thd inside ¼-20 x 0.625" deep	1	CE 11941	39
CE 87454	Lamp Socket Assembly	1	CE 11941	39
CE 87465	Container, Paper	1	CE 87059	46
CE 87471	Link: CS, cad. pl	1	CE 87068	49
CE 87472	Washer, Lock: round; stl, cad. pl; internal teeth; 0.172" ID; 0.330" OD; 0.020" thk; Shakeproof # 1208-00	1	CE 87059	46
CE 87499-20	Case, Packing: for one rotor stepping unit, permanent shipping container, single wall corrugated strawboard	1	Main	NI
CE 87499-24	Case, Packing: for six power converters or six printers, single wall corrugated strawboard	1	Main	NI
CE 87499-25	Case, Packing: for spare parts kit	1	Main	NI
CE 87499-26	Case, Packing: for spare parts kit	1	Main	NI
CE 87499-27	Case, Packing: for spare parts kit	1	Main	NI
CE 87499-28	Case, Packing: permanent storage for 24 lubricant containers, single wall corrugated board	1	Main	NI
CE 88000	Motor-Generator and Controller Box	1	CE 87059	57B
CE 88001	Motor-Generator	1	CE 88000	57B
CE 88002	Controller Box	1	CE 88000	57B
CE 88003	Cover, Controller Box	1	CE 88000	57B
CE 88004	Stator and Flange Head	1	CE 88001	57B
CE 88005	Yoke and Field Coil	1	CE 88001	57B
CE 88006	End Cap	1	CE 88001	57B
CE 88007	Armature Assembly: Input-24v DC, 1.25 amps; Output-single phase, 6600 rpm, 440 cyl, 205v AC peak, 0.20 h.p.; special feature non-magnetized. Type MG-27B	1	CE 88001	57B
CE 88008	Brush Retaining Cap: black phenolic	2	CE 88001	57B
CE 88009	Rod: aluminum; 0.164" dia ±0.002"; 1.812" lg; both ends tapped # 4-40 x 0.312" deep	1	CE 88000	57B
CE 88012	Lead Wire Assembly: 2 wire, # 24 ga 0.020 wire, type WL cable, tubing # 11 Awg	1	CE 88001	57B
CE 88015	End Cap, Inverter: cylindrical; 2.750" dia (max), 1.227" deep	1	CE 88006	57B
CE 88016	Brush Holder: silver plate	2	CE 88006	57B
CE 88020	Cover, End: aluminum casting, painted	1	CE 88000	57B
CE 88021	Screw: CS; Hex H, slot drive; # 6-32 x 0.250" lg; 0.344" loa	2	CE 88000	57B
CE 88022	Gear	1	CE 88000	57B
CE 88023	Screw: stl, cad. pl, black dip; FH, csk, hex socket drive; # 6-32 x 0.875" (actual); 4.312" loa	2	CE 88001	57B
CE 88024	Sleeving: # 7 Awg, glass base, silicone varnish impregnated, natural cream color, 0.016" wall thickness; 1 1/16" lg; 0.151" ID	2	CE 88001	57B
CE 88028	Slinger, Oil: CS, cad. pl; 0.298" ID; 0.625" OD; 0.016" thk (recessed at center 0.312" ID)	1	CE 88001	57B
CE 88029	Brush, Motor: 18 coils, 0.0126" dia phosphor bronze spring wire, carbon brush (40 strands 0.002" copper lead wire)	2	CE 88001	57B
CE 88030-1	Positive Brush Assembly: carbon brush, grade 38-F-1 or equal; 0.013" phosphor bronze spring wire; 25 coils; copper terminals, silver pl; connecting lead of 66 strands 0.002" dia copper wire; brush stamped "+"	1	CE 88029	57B
CE 88030-2	Negative Brush Assembly: 25 coils 0.012" phosphor bronze spring wire; 66 strands 0.002" dia copper wire; carbon brush; stamped "-"	1	CE 88029	57B

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 88031	Governor, Motor: centrifugal switch type BS9, range of speed adjustment 6600 ±100 rpm; 1½" dia x 0.437" deep; Lee Mfg. Co. No. AN 565DC8H2	1	CE 88001	57B
CE 88032	Plate, Retaining: CS, cad. pl; ctr hole 0.125" dia, csk; 0.040" thk	1	CE 88001	57B
CE 88033	Screw: stl, cad. pl; FH, csk, hex socket drive; #4-40 x 0.172" loa	4	CE 88001	57B
CE 88034	Shim, Washer: round; brass, cad. pl; 0.437" ID; 0.735" OD; 0.006" thk	as req	CE 88001	57B
CE 88035	Standoff: CS, cad. pl; hex shape; 0.281" w across flats; 1.292" lg; one end tapped #6-32	2	CE 88001	57B
CE 88036	Resistor, Fixed, Composition: cyl; 0.132" dia x 0.687" lg; 100 ohms ± 10%; 2 watts power dissipation; 1 No. 19 wire term. each end; Mil-R-11/6 type RC42GF101K	1	CE 88000	57B
CE 88037	Capacitor: 500 wv DC, 0.00068 ± 10% microfarad; molded disk; 2 #22 tinned copper terminals; ¼" dia; 0.187" thk; Centralab type MD ISO-KA-5	1	CE 88000	57B
CE 88040	Resistor, Fixed: WW; 31 ohms; 8 watts; 2 mtg tabs w/ 0.085" dia hole; 1.750" lg x 0.312" dia; type RW29G310	1	CE 88000	57B
CE 88041	Cover, Controller Box	1	CE 88003	57B
CE 88042	Paper, Fish	1	CE 88003	57B
CE 88045	Grommet: round; rubber; 0.187" ID; 0.437" OD; 0.187" thk; groove ¼" w	1	CE 88002	57B
CE 88048	Clamp, Lead: CS, cad. pl, black dip; 0.687" lg; 0.312" w; mtg hole 0.172" dia	1	CE 88001	57B
CE 88050	Insulator, Field Coil: fish paper; 1.500" lg x 1.360" w x 0.031" thk	2	CE 88005	57B
CE 88053	Brush, Governor: nylon molding compound	2	CE 88006	57B
<del>CE 88066</del>	<del>AC Power Converter Assembly</del>	<del>1</del>	<del>CE 87075</del>	<del>56</del>
CE 88084	Bearing, Ball: 0.2362" ID; 0.7480" OD; 0.276" w; six ¼" balls; Norma-Hoffman spl ball bearing No. C-96 KK w/7mm width	2	CE 88001	57B
CE 88085	Key: stainless stl; 0.400" lg; 0.078" w ±.003"; 0.0617" thk ±.0005"; AISI Type 302	1	CE 88001	57B
CE 88124	Capacitor: cyl; 0.438" dia x 1.188" lg; metallic paper; 0.5 ±0.05 microfarads; 200 wv DC (tinned 0.032" solid copper wire leads each end)	1	CE 11941	39
*CE 88143	Cap, Brush Retaining Assembly: molded bakelite; 0.437" ID; 0.563" OD; 0.250" thk; knurled, medium; EM-2, Grade 9, BM-6260 black (same as Bendix RB-3142-1C)	2	CE 87419	42
CE 88144	Clamp, Cable (Fastener, Cord Assembly): carbon steel, AISI Type C1012, cad. pl; ½" w; 0.032" thk; 1 hole 0.172" dia	1	CE 87422	57A
CE 88146	Screw: SS; cad. pl; black dip; FH, hex socket drive; #2-56 x 0.187" loa	7	CE 11549	49
CE 88150	Ring, Retaining, External: beryllium copper; 0.338" ID; 0.025" thk; Waldes Kohinoor Inc., Part No. 5100-37-C	1	CE 11531	47
CE 88156	Plate, Identification: aluminum, 3.000" x 0.968" x 0.031"; 4 mtg holes, 0.067" dia	1	CE 87077	51
CE 88157	Plate, Identification: aluminum, 2.250" x 0.844" x 0.031"; 4 mtg holes, 0.101" dia	1	CE 87068	49
CE 88158	Plate, Identification: aluminum; 2.250" x 0.844" x 0.010"; 4 mtg holes, 0.064" dia	1	CE 87067	50
CE 88159	Plate, Identification: aluminum; 3.000" x 0.750" x 0.031"; 4 mtg holes, 0.067" dia	1	CE 87069	53

\*Obsolete But Supplied.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On	Fig. No.
CE 88160	Plate, Identification: aluminum; 3.000" x 0.968" x 0.031"; 4 mtg holes 0.067" dia.....	1	CE <del>88086</del> <sup>87066</sup>	55
CE 88161	Plate, Identification: aluminum; 3.000" x 0.750" x 0.031"; 4 mtg holes 0.067" dia.....	1	CE 87075	54
CE 88163	Plate, Identification: aluminum; 2.500" x 0.843" x 0.031"; 4 mtg holes 0.104" dia (Operator's Accessory).....	1	CE 87290	57
CE 88164	Plate, Identification: aluminum; 2.500" x 0.656" x 0.031"; (Operator's Maintenance).....	1	CE 87450	57
CE 88165	Spacer: aluminum alloy; 0.510" dia, thd ¼-16.....	2	CE 88166	40
CE 88166	Post, Fuse.....	2	CE 11371	40
CE 88167	Nut.....	2	CE 88166	40
CE 88169	Washer, Lock: CS, cad. pl; 0.562" ID; 0.700" OD; 0.032" thk.....	2	CE 88166	40
CE 88273	SEAL, SPACER BAR, NEOPRENE RUBBER, BLACK; 0.125 IN. THK. X 0.593 IN. W. X 0.750 IN. LG.	4	CE 11371	40

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## APPENDIX A

## LIST OF RECOMMENDED TOOLS

- AT 16603.....Riveting Fixture for cipher unit
- CE 862.....Orange Stick
- CE 863.....Crocus Cloth: 1 pc, approx 3" x 4"
- CE 10175.....Key, Short Arm: Allen #316; 1/16" hex
- CE 14685.....Brush, Cleaning: small; 1/4"
- CE 14686.....Hammer, Machinist Riveting: 4 oz
- CE 14689.....Key, Short Arm: Allen #18; 2 1/2" lg; 1/4" hex
- CE 14690.....Pliers: Waldes Kohinoor #1
- CE 14691.....Pliers: Waldes Kohinoor #0018
- CE 14692.....Pliers: Waldes Kohinoor # 0015
- CE 14693.....Key Set: Allen Handi-Hex #6075 (includes two L-type adjusting keys, and five "Handi-Hex" keys as follows)
- CE 14792 KEY, "HANDI-HEX": Allen #607-050S; blade 0.050" hex x 3" lg; plastic handle
- CE 14793 KEY, "HANDI-HEX": Allen #607-116S; blade 1/16" hex x 3" lg; plastic handle
- CE 14794 KEY, "HANDI-HEX": Allen #607-564S; blade 1/4" hex x 3" lg; plastic handle
- CE 87475 KEY, "HANDI-HEX": Allen #607-18S; blade 1/8" hex x 3" lg; plastic handle
- CE 87476 KEY, "HANDI-HEX": Allen #607-332S; blade 3/16" hex x 3" lg; plastic handle
- CE 14697.....Soldering Iron: pencil type; Ungar #776
- CE 14698.....Multimeter: Simpson Model 260
- CE 14699.....Revolution Counter: L. S. Starrett #107
- CE 14700.....Pliers: Waldes Kohinoor #2 (90-degree bend)
- CE 14702.....Wrench, Spanner: special; to fit key switch nuts
- CE 87052.....Test Base Assembly: special; permits access to electrical components
- CE 87282.....Oil: Stano-drip #29, 8-oz can
- CE 87283.....Grease: Molylube #50, 8-oz can
- CE 87290.....Operator's Accessory Kit: Contains following items: (Parts may be ordered individually).
- CE 14517 FIGURE LAMP
- CE 14760 OPERATOR LAMP
- CE 87240 PIN STRAIGHTENER; 7 and 9 pin
- CE 87273 TUBE PULLER; 9 pin
- CE 87274 TUBE PULLER; 7 pin
- CE 87291 BRUSH: sash-type cleaning; large
- CE 87292 BRUSH; toothbrush-type cleaning
- CE 87293 CLEANING BLOCK ASSEMBLY
- CE 87294 TAPE MOISTENER
- CE 87295 THIMBLE, TAPE CUTTER
- CE 87296 ERASER
- CE 87297 ROTOR LUBRICANT; Quietone; 8-oz can
- CE 87298 TWILLJEAN CLOTH; package
- CE 87299 WEB STRAP; for CE 87293 Cleaning Block Assembly
- CE 87402.....Wrench: special; to remove yoke
- CE 87403.....Key Top Puller: special

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

- CE 87450.....Operator's Maintenance Kit: includes CE 87290 (OPERATOR'S ACCESSORY KIT) and following parts in CE 87470 (WRENCH SET): (Parts may be ordered individually).  
 CE 14794 KEY, "HANDI-HEX": Allen #607-564S; blade  $\frac{3}{4}$ " hex x 3" lg; plastic handle  
 CE 87473 KEY, SHORT ARM: Allen #316;  $\frac{3}{16}$ " hex  
 CE 87474 BRUSH: paintbrush-type; cleaning;  $\frac{1}{2}$ "  
 CE 87475 KEY, "HANDI-HEX": Allen #607-18S; blade  $\frac{1}{4}$ " hex x 3" lg; plastic handle  
 CE 87476 KEY, "HANDI-HEX": Allen #607-332S; blade  $\frac{3}{8}$ " hex x 3" lg; plastic handle  
 CE 87477 BLADE: Allen #609-316T;  $\frac{3}{16}$ " x 6" lg; 3 used; used in CE 87478 (KEY)  
 CE 87478 KEY, T-HANDLE: Allen #609-316T;  $\frac{3}{16}$ " socket; uses CE 87477 blades  
 CE 87479 BLADE: Allen #609-532T;  $\frac{3}{8}$ " hex x 6" lg; 3 used in CE 87480 (KEY)  
 CE 87480 KEY, T-HANDLE: Allen #609-532T;  $\frac{3}{8}$ " socket; uses CE 87479 blades
- CE 87482.....Prewinder: inserting tool for #6-32 Heli-Coil insert  
 CE 87483.....Prewinder: inserting tool for #8-32 Heli-Coil insert  
 CE 87474.....Tang Break-Off Tool: Manual; for #6-32 Heli-Coil insert  
 CE 87485.....Tang Break-Off Tool: Manual; for #8-32 Heli-Coil insert  
 CE 87486.....Extracting Tool: for #6-32 and #8-32 Heli-Coil inserts  
 CE 87488.....Spring Bender: special; type A  
 CE 87490.....Spring Bender: special; type B  
 CE 87493.....Adjusting Tool: special; to adjust print magnet and print wheel  
 CE 87494.....Wrench, Spanner: special; combination-type to fit figured wheel and to hold ribbon reel drive assembly  
 CE 87496.....Adjusting Gage: special; to adjust actuator switches and drive pawls  
 CE 87497.....Key: Allen, L-shaped; special; to adjust print magnet
- 73406.....Tweezers:  $4\frac{1}{8}$ " lg  
 75503.....Spring Hook: push  
 75765.....Spring Hook: pull  
 82711.....Spring Scale: 64 oz; push-pull type  
 88993.....Burnisher, Contact:  $2\frac{3}{8}$ " lg; plastic handle  
 89955.....Wrench, Socket: for  $\frac{3}{16}$ " hex nut;  $4\frac{1}{8}$ " lg; wood handle  
 93322.....Gage, Ribbon: 0.004" thk  
 93325.....Gage, Wire: 0.025" OD  
 93328.....Gage, Wire: 0.012" OD  
 95367.....Wrench, Open-End:  $\frac{1}{4}$ " x  $\frac{3}{16}$ "  
 96356.....Gage, Ribbon: 0.002" thk  
 96360.....Gage, Ribbon: 0.006" thk  
 96373.....Gage, Wire: 0.010" OD  
 96375.....Gage, Wire: 0.015" OD  
 96377.....Gage, Wire: 0.020" OD  
 96380.....Nest, Gage: holds 8 gages  
 96385.....Gage, Wire: 0.040" OD  
 100638.....Oiler, One Drop  
 100982.....Screw Driver:  $9\frac{1}{2}$ " loa; blade 6" lg; tip  $\frac{3}{16}$ "; sliding spring clip and plastic handle  
 108285.....Pliers, Long Nose:  $6\frac{3}{8}$ " loa  
 108286.....Pliers, Diagonal Cutting: 5" loa  
 110443.....Spring Scale: 8 oz; push-pull type  
 110444.....Spring Scale: 32 oz; push-pull type
- FSN 8010-161-7367.....Glyptal: General Electric Grade 1153

~~CONFIDENTIAL~~

## APPENDIX B

The following table contains information concerning the disposition of replacement parts effected by changes in the TSEC/KL-7.

## ACTION COLUMN KEY

A—Added

D—Deleted

M—Modified

S/B—Substituted by

S/F—Substituted for

Part No.	Nomenclature	Action	Affected Part	Inter-change-able	Disposition	Reason For Change
CE 11011	Screw	S/B	CE 88146 Screw	NO	Use in other positions	To provide more secure stepping magnet assy
CE 11013	Motor Generator and Controller Assy.	S/B	CE 87420 Motor Generator and Controller Assy	YES	Interchange below #4337	To change from magnesium to aluminum
CE 11014	Motor Generator	S/B	CE 87419 Motor Generator	YES	Interchange below #4337	To change from magnesium to aluminum
CE 11018	Insulating Board and Clip	S/B	CE 87000 Insulating Board Clip	NO	Do not use	To accomodate new resistor
CE 11045	Bracket, LH	S/B	CE 87027 Bracket, LH	YES	Interchange below #4337	To change from magnesium to aluminum
CE 11046	Support	S/B	CE 87028 Support	YES	Interchange below #4337	To change from magnesium to aluminum
CE 11081	Hub	S/B	CE 87029 Hub	YES	Interchange below #4337	To change from magnesium to aluminum
CE 11062	Figured Wheel	M		YES		To improve legibility of printing

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Inter-change-able	Disposition	Reason For Change
CE 11064	Contact	S/B	CE 87267 Contact	NO	Use in other positions	(See CE 87267)
CE 11068	Frame	S/B	CE 87243 Frame	NO	Do not use	(See CE 87264)
CE 11093	Plate and Contact	M		YES		To prevent sticking of end plate due to swelling in KLK-7/TSEC
CE 11095	Gear and Pinion	S/B	CE 87173 Gear and Pinion	NO	Do not use	
CE 11108	Rotor	S/B	CE 87383 Stator and End Bell Assy	YES	Assemble at high echelon	To select fit for closer tolerances
CE 11105	Cover	M		YES		To change phenolic to aluminum
CE 11111	Carrying Case	S/B	CE 87069 Cover and CE 87070 Carrying Case	NO	Use component parts	To permit stocking as component parts
CE 11127	Cover	M		YES		To change phenolic to aluminum
CE 11133	Timing Shaft	S/B	CE 87330 Timing Shaft	YES	Must be select fitted	To select fit for closer tolerances
CE 11144	Plate and Contact, LH	S/B	CE 87264 Plate and Contact, LH	YES	Must be modified	To insure correct insertion of KLK-7/TSEC in KLA-7/TSEC
CE 11154	Key Switch	S/B	CE 54582 Key Switch	NO	Do not use	To provide more securely mounted key
CE 11176	Clutch	S/B	CE 87330 Timing Shaft	YES	Must be select fitted	To select fit for closer tolerances
CE 11198	Support Casting	S/B	CE 87038 Support Casting	YES	Interchange below # 4937	To change from magnesium to aluminum
CE 11200	Resistor	S/B	CE 87002 Resistor	NO	Do not use	To provide better electrical operation
CE 11224	Link	S/B	CE 87471 Link	NO	Do not use	(See CE 87471)

304

Change No. 1

KAM-1/TSEC



~~CONFIDENTIAL~~

3041

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Inter-changeable	Disposition	Reason For Change
CE 11228	Spacer	A				(See CE 87011)
CE 11234	Housing	M		YES		To permit sliding contact board to close power circuit in D operation
CE 11258	Dust Cap	D			Do not use	New key switch obsoletes this part
CE 11273	Bearing	S/B	CE 14595 Bearing	YES	Stock as CE 14595	Manufacturer's stocking change
CE 11276	Loading Spring	S/B	CE 87883 Stator and End Bell Assy	YES	Assemble at high echelon	To select fit for closer tolerances
CE 11278	Key	S/B	CE 87171 Key	NO	Do not use	
CE 11286	Stator and Contact	S/B	CE 87383 Stator and End Bell Assy	YES	Assemble at high echelon	To select fit for closer tolerances
CE 11287	Stator and Contact	S/B	CE 87383 Stator and End Bell Assy	YES	Assemble at high echelon	To select fit for closer tolerances
CE 11288	Pulse Generator	S/B	CE 87056 Pulse Generator	YES	Interchange below #4337	To change from magnesium to aluminum
CE 11293	Plate	S/B	CE 87039 Plate	YES	Interchange below #4337	To change from magnesium to aluminum
CE 11306	Fuse Holder	S/B	CE 88166 Fuse Post	NO	Do not use	To provide corrosion resistant receptacle for fuse
CE 11311	Nut	S/B	CE 88167 Nut	NO	Do not use	To provide corrosion resistant receptacle for fuse
CE 11312	Washer	D			Do not use	(See CE 54548)

~~CONFIDENTIAL~~

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Inter-change-able	Disposition	Reason For Change
CE 11318	Gasket	D			Do not use	
CE 11850	Key Chassis	S/B	CE 87265 Key Chassis	NO	Do not use	To permit use of new key switches
CE 11385	Spacer	S/F	CE 11886 Spacer	YES		To change stocking procedure from assembly to component parts
CE 11386	Spacer	S/B	CE 11385 Spacer and CE 14595 Ball Bearing	YES	Stock components of CE 11886	(See CE 11385)
CE 11408	Paper Container	S/B	CE 87465 Paper Container	NO	Do not use	To provide more protection against weather
CE 11408	Paper Container	M		NO	Do not use	To provide better weather protection
CE 11412	Screw	A				(See CE 87019)
CE 11412	Screw	S/B	CE 11555 Screw	NO	Use in other positions	(See CE 54552 and CE 54550)
CE 11429	Spring Hood	A				(See CE 11408)
CE 11431	Latch, RH	S/B	CE 54529 Latch, RH	NO	Do not use	
CE 11433	Support, RH	S/B	CE 54531 Support, RH	NO	Do not use	
CE 11439	Bearing	D			Do not use	To delete this item from spare parts list
CE 11443	Shaft	S/B	CE 87417 Shaft	NO	Do not use	(See CE 87417)
CE 11448	Support, LH	S/B	CE 54530 Support, LH	NO	Do not use	
CE 11464	Leaf	S/B	CE 87008 Leaf	NO	Use in other positions	(See CE 87062)
CE 11467	Housing	S/B	CE 87047 Housing	YES	Interchange below # 4337	To change from magnesium to aluminum

3042

Change No. 1

KAM-1/TSEC

~~CONFIDENTIAL~~

304.3

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 11481	Print Magnet	S/B	CE 87019 Print Magnet	NO	Do not use	To permit adjustment of print magnet
CE 11517	Dowel Pin	A				To modify KLA-7/TSEC frame
CE 11518	Dowel Pin	A				To modify KLA-7/TSEC frame
CE 14518	Bracket	S/B	CE 87262 Bracket	YES	Rework Bracket	(See CE 87262)
CE 11523	Switch	S/B	CE 87011 Switch	NO	Components of switch assy are interchangeable	To facilitate adjustment of switches
CE 11533	Timing Unit	S/B	CE 87058 Timing Unit	YES	Interchange below # 4337	To change from magnesium to aluminum
CE 11535	Retaining Ring	S/B	CE 87098 Retaining Ring	NO	Use in other positions	(See CE 87019)
CE 11542	Rivet	S/B	CE 87131 Rivet	NO	Do not use	(See CE 87131)
CE 11548	Armature	M		NO	Do not use	(See CE 87131)
CE 11555	Screw	S/F	CE 11412 Screw	NO		(See CE 54552 and CE 54550)
CE 11556	Screw	S/F	CE 11850 Screw	NO		(See CE 54552 and CE 54550)
CE 11556	Screw	S/F	CE 14490 Screw	YES		Manufacturer's Change
CE 11560	Mounting Plate	D			Do not use	(See CE 87011)
CE 11562	Panel	S/B	CE 87003 Panel	NO	Do not use	To provide new board to mount new resistor
CE 11566	Printer	S/B	CE 87059 Printer	YES	Interchange below # 4337	To change from magnesium to aluminum
CE 11571	Lamp Socket	S/B	CE 87454 Lamp Socket	YES	Rework before using	(See CE 87454)

~~CONFIDENTIAL~~

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 11573	Canopy	S/B	CE 87453 Canopy	YES	Paint to specs	(See CE 87454)
CE 11592	Ratchet and Bushing	S/B	CE 54542 Ratchet and Bushing	NO	Do not use	
CE 11603	Pawl	S/B	CE 54579 Pawl	NO	Do not use	(See CE 54571)
CE 11604	Pawl	S/B	CE 54580 Pawl	NO	Do not use	(See CE 54571)
CE 11623	Eccentric	S/B	CE 87231 Eccentric	NO	Do not use	(See CE 54571)
CE 11643	End Bell & Tape Feed	S/B	CE 87383 Stator and Bell	NO	Assemble at high echelon	To select fit for closer tolerances
CE 11648	Dowel Pin	S/B	CE 87014 Shoulder Pin	NO	Do not use	(See CE 87019)
CE 11676	Bottom Cover	S/B	CE 87095 Bottom Cover	NO	Do not use	(See CE 87095)
CE 11689	Spring	S/B	CE 54544 Spring	NO	Do not use	
CE 11696	Pawl	S/B	CE 87232 Pawl	NO	Do not use	(See CE 54571)
CE 11707	Turret Lug	S/B	CE 14766 Turret Lug	NO	Do not use	To facilitate soldering of lugs
CE 11716	Spring	S/B	CE 54544 Spring	NO	Do not use	(See CE 54544)
CE 11721	Housing	S/B	CE 87061 Housing	YES	Interchange below #4337	To change from magnesium to aluminum
CE 11727	Cam Switch and Trip Magnet	S/B	CE 87062 Cam Switch and Trip Magnet	YES	Interchange below #4337	To change from magnesium to aluminum
CE 11762	Retaining Ring	S/B	CE 88150 Retaining Ring	NO	Do not use	(See CE 54592)
CE 11789	Key Switch	S/B	CE 54583 Key Switch	NO	Do not use	To provide more securely mounted key switch
CE 11800	Transformer	M		YES		To provide better current output

304.4

Change No. 1

KAM-1/TSEC

~~CONFIDENTIAL~~

3045

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Inter-change-able	Disposition	Reason For Change
CE 11820	Setscrew	S/F	CE 14710 Setscrew	NO		To eliminate helicoil insert
CE 11820	Setscrew	M		NO	Do not use	To change dimensions
CE 11821	Hex Nut	A				(See CE 87262)
CE 11824	Screw	S/B	CE 87383 Stator and End Bell	NO	Assemble at high echelon	To select fit for closer tolerances
CE 11825	Lock washer	A				(See CE 87262)
CE 11826	Lock washer	A				(See CE 87264)
CE 11829	Screw	S/B	CE 54521 Screw	NO	Do not use	
CE 11830	Lock washer	A				(See CE 87422)
CE 11832	Screw	S/F	CE 11849 Screw	YES		Manufacturer's change
CE 11833	Screw	A				(See CE 87422)
CE 11834	Screw	S/F	CE 87383 Stator and End Bell	YES	Assemble at high echelon	To select fit for closer tolerances
CE 11838	Screw	A				(See CE 87422)
CE 11841	Screw	S/B	CE 87447 Screw	NO	Use in other positions	(See CE 87447)
CE 11849	Screw	S/B	CE 11832 Screw	YES	Stock as CE 11832	Manufacturer's change
CE 11850	Screw	S/B	CE 11556 Screw	NO	Do not use	(See CE 54522 and CE 54550)
CE 11855	Screw	S/B	CE 87446 Screw	NO	Use in other positions	(See CE 87447)
CE 11860	Rivet	A				To secure name plates

~~CONFIDENTIAL~~

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 11863	Tape Holder	M		YES		To facilitate threading of tape by flaring ends of tape holder
CE 11864	Shell	S/B	CE 87159 Shell	NO	Do not use	(See CE 87157)
CE 11866-1-11	Sleeving	A				(See CE 88124)
CE 11869	Spring	S/B	CE 87229 Spring	NO	Do not use	(See CE 87229)
CE 11915	Double Drive Ratchet	S/B	CE 54543 Double Drive Ratchet	NO	Do not use	
CE 11917	Drive Ratchet	S/B	CE 54571 Drive Ratchet	NO	Do not use	To expand adjustment tolerances in paper tape feed mechanism
CE 11927	End Bell	S/B	CE 87383 Stator and End Bell	NO	Assemble at high echelon	To select fit for closer tolerances
CE 11927	End Bell	S/B	CE 87020 End Bell	NO	Do not use	To permit adjustment of print magnet
CE 11932	End Bell	S/B	CE 87383 Stator and End Bell	NO	Assemble at high echelon	To select fit for closer tolerances
CE 11941	Contact Panel	M		NO	Do not use	To include modifications in wiring
CE 11949	Clevis Pin	M		NO	Do not use	To minimize falling off of retaining ring owing to machine vibration
CE 11952	Name Plate	S/B	CE 88156 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 11970	Rectifier	M		YES		To provide better current output
CE 11987	Capacitor	S/B	CE 88124 Capacitor	NO	Use in other positions	To prevent spurious oscillations in trip magnet and capacitors
CE 11994	Name Plate	S/B	CE 88157 Name Plate	NO	Do not use	To change to TSEC nomenclature

304.6

Change No. 1

KAM-1/TSEC

~~CONFIDENTIAL~~

304.7

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 11995	Bracket	M		YES		Manufacturer's change
CE 11998	Guide Plate	S/B	CE 87251 Guide Plate	NO	Do not use	(See CE 87251)
CE 14903	Copy Holder	S/B	CE 87130 Copy Holder	NO	Do not use	(See CE 87130)
CE 14328	Name Plate	S/B	CE 88160 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 14329	Name Plate	S/B	CE 88161 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 14428	Rivet	D			Do not use	To permit replacement of power switch
CE 14448	Screw	S/B	CE 54572 Screw	NO	Do not use	(See CE 54572)
CE 14465	Frame	S/B	CE 87252 Frame	NO	Do not use	(See CE 87251)
CE 14479	Cover Plate	D			Do not use	(See CE 87422)
CE 14486	Rivet	A				To secure name plates
CE 14490	Screw	S/B	CE 11556 Screw	YES	Stock as CE 11556	Manufacturer's change
CE 14503	Drive Screw	A				To secure name plates
CE 14504	Base	S/B	CE 87049 Base	YES	Interchange below #4337	To change from magnesium to aluminum
CE 14509	Stop Pin	A				To provide stop position for access to KLK-7/TSEC
CE 14513	Latch, LH	S/B	CE 54532 Latch, LH	NO	Do not use	
CE 14514	Latch, RH	S/B	CE 54533 Latch, RH	NO	Do not use	
CE 14518	Bracket, RH	S/B	CE 87262 Bracket, RH	YES	Drill holes to relocate Storage plug	(See CE 87262)

~~CONFIDENTIAL~~

KAM-1/TSEC

CONFIDENTIAL

304.8

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Inter-changeable	Disposition	Reason For Change
CE 14521	Spring Stop	M		NO	Do not use	(See CE 14509)
CE-14535	Base	S/B	CE 87041 Base	YES	Interchange below #4337	To change from magnesium to aluminum
CE 14549	Latch, LH	S/B	CE 54528 Latch, LH	NO	Do not use	
CE 14558	Pin	S/B	CE 54584 Pin	NO	Do not use	(See CE 54584)
CE 14559	Shaft	S/B	CE 87380 Shaft	NO	Do not use	To improve mechanical action
CE 14561	Name Plate	S/B	CE 88158 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 14563	AC Power Converter	S/B	CE 87066 AC Power Converter	YES	Interchange below #4337	To change from magnesium to aluminum
CE 14570	Stepping Unit	S/B	CE 87068 Stepping Unit	YES	Interchange below #4337	To change from magnesium to aluminum
CE 14595	Bearing	S/F	CE 11386 Spacer	YES		To change stocking procedures from assembly to component parts
CE 14595	Bearing	S/F	CE 11273 Bearing	YES		Manufacturer's stocking change
CE 14605	Stationary Ring	M		YES		To improve legibility
CE 14606	Washer	A				To secure Name Plate
CE 14608	Name Plate	S/B	CE 88159 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 14613	Paper Storage	D			Do not use	To eliminate unnecessary item
CE 14614	Drive Screw	A				To secure Name Plates
CE 14616	Cover	S/B	CE 87248 Cover	NO	Do not use	

CONFIDENTIAL

KAM-1/TSEC



~~CONFIDENTIAL~~

304.9

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 14630	Case	S/B	CE 87070 Case	NO	Do not use	
CE 14638	Setscrew	D			Do not use	(See CE 87262)
CE 14639	Bearing Plate	D			Do not use	(See CE 87262)
CE 14640	Storage Plug	S/B	CE 87261 Storage Plug	NO	Do not use	
CE 14642	Storage Plug	S/B	CE 87261 Storage Plug	NO	Do not use	(See CE 87262)
CE 14644	Jam Nut	D			Do not use	(See CE 87262)
CE 14646	Bracket	S/B	CE 87044 Bracket	YES	Interchange below # 4337	To change from magnesium to aluminum
CE 14647	Bracket, LH	S/B	CE 87045 Bracket, LH	YES	Interchange below # 4337	To change from magnesium to aluminum
CE 14648	Base	S/B	CE 87046 Base	YES	Interchange below # 4337	To change from magnesium to aluminum
CE 14661	Drawer	S/B	CE 87072 Drawer	YES	Interchange below # 4337	To change from magnesium to aluminum
CE 14662	Drawer	S/B	CE 87043 Drawer	YES	Interchange below # 4337	To change from magnesium to aluminum
CE 14665	Container	D			Do not use	To eliminate unnecessary item
CE 14667	Spring	D			Do not use	(See CE 14665)
CE 14668	Pin	D			Do not use	(See CE 14665)
CE 14671	Cover	S/B	CE 87074 Cover	YES	Interchange below # 4337	To change from magnesium to aluminum

~~CONFIDENTIAL~~

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 14672	Accessories and Case	S/B	CE 37075 Accessories and Case	NO	Do not use	
CE-14676	Case	S/B	CE 37076 Case	YES	Interchange below #4337	To change from magnesium to aluminum
CE 14683	Screw	A				(See CE 37264)
CE 14684	Name Plate (Office Case)	S/B	CE 37156 Name Plate	NO	Do not use	
CE 14709	Helicoil	D			Do not use	(See CE 11820)
CE 14710	Setscrew	S/B	CE 11820 Setscrew	NO	Do not use	(See CE 11820)
CE 14717	Test Base	S/B	CE 37052 Test Base	YES	Interchange below #4337	To change from magnesium to aluminum
CE 14766	Turret Lug	S/F	CE 11707 Turret Lug	NO	Do not use	To facilitate soldering
CE 14769	Pin	M		NO	Do not use	(See CE 14798)
CE 14771	Washer	A				(See CE 54552 and CE 54550)
CE 14798	Socket	M		NO		To keep light from jumping out by providing J shaped slot
CE 54521	Screw	S/F	CE 11829 Screw	NO		
CE 54528	Latch, LH	S/F	CE 14549 Latch, LH	NO		
CE 54529	Latch, RH	S/F	CE 11431 Latch, RH	NO		
CE 54530	Support, LH	S/F	CE 11448 Support, LH	NO		
CE 54531	Support, RH	S/F	CE 11433 Support, RH	NO		

304.10

Change No. 1

KAM-I/TSEC

~~CONFIDENTIAL~~

304.11

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 54532	Latch, LH	S/F	CE 14513 Latch, LH	NO		
CE 54533	Latch, RH	S/F	CE 14514 Latch, RH	NO		
CE 54535	Bushing	S/B	CE 87281 Bushing	NO	Do not use	(See CE 87281)
CE 54536	Key Switch	S/B	CE 87288 Key Switch	NO	Do not use	(See CE 87288)
CE 54537	Key Switch	S/B	CE 87286 Key Switch	NO	Do not use	(See CE 87288)
CE 54542	Ratchet and Bushing	S/F	CE 11592 Ratchet and Bushing	NO		
CE 54543	Double Drive Ratchet	S/F	CE 11912 Double Drive Ratchet	NO		
CE 54544	Spring	S/F	CE 11716 Spring	NO		To minimize wear on detent pawl
CE 54544	Spring	S/F	CE 11689 Spring	NO		
CE 54546	Capacitor	S/B	CE 87279 Capacitor	NO	Do not use	
CE 54548	Lock washer	A	CE 88169 Lock washer	NO	Do not use	(See CE 88166)
CE 54548	Lock washer	M		YES		Moved to prevent mechanical interference with movement of sliding contact board
CE 54549	Dust Cover, R Front	A				To protect tape feed mechanism from dust
CE 54550	Dust Cover, R Rear	A				To protect timing unit from dust
CE 54551	Dust Cover, L Front	A				To protect tape feed mechanism from dust
CE 54552	Dust Cover, L Rear	A				To protect timing unit from dust

~~CONFIDENTIAL~~

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 54568	Internal Tooth Lock Washer	A				To secure selector handle against vibration of machine
CE 54571	Drive Ratchet	S/F	CE 11917 Drive Ratchet	NO		To expand adjustment tolerances in paper tape feed mechanism
CE 54572	Screw	S/F	CE 14448 Screw	NO		To utilize ratchet type screws to secure KLA-7/TSEC
CE 54579	Pawl	S/F	CE 11603 Pawl	NO		(See CE 54571)
CE 54580	Pawl	S/F	CE 11604 Pawl	NO		(See CE 54571)
CE 54582	Key Switch	S/F	CE 11154 Key Switch	NO		To provide more securely mounted keys
CE 54583	Key Switch	S/F	CE 11789 Switch	NO		To provide more securely mounted keys
CE 54584	Pin	S/F	CE 14558 Pin	NO		To insure functioning of counter
CE 54589	Damper Leaf	A				(See CE 87062)
CE 54590	Damper Leaf	A				(See CE 87062)
CE 54591	Brake Washer	A				To minimize ribbon drag and hasten reversal of inked ribbon
CE 54592	Compression Spring	S/F	CE 87136 Compression Spring	NO		To provide more efficient spring
CE 54599	Spacer	S/B	CE 87383 Stator and End Bell	NO	Assemble at high echelon	To select fit for closer tolerances
CE 54599	Spacer	A				End bells on stator and end bell assembly can be correctly aligned

304.12

Change No. 1

KAM-1/TSEC

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Part No.	Nomenclature	Action	Affected Part	Inter-change-able	Disposition	Reason For Change	
CE 87000	Insulating Board and Clip Assy	S/F	CE 11018 Insulating Board and Clip	NO	Assemble at high echelon	To provide new board for new resistor	
CE 87002	Resistor	S/F	CE 11200 Resistor	NO		(See CE 87000)	
CE 87003	Panel	S/F	CE 11562 Panel	NO		(See CE 87000)	
CE 87008	Leaf	S/F	CE 11454 Leaf	NO		(See CE 87062)	
CE 87011	Switch	S/F	CE 11523 Switch	NO		To facilitate adjustment of switches	
CE 87012	Pivot Pin	A				(See CE 87019)	
CE 87014	Shoulder Pin	S/F	CE 11648 Dowel Pin	NO		(See CE 87019)	
CE 87015	Eccentric	A				(See CE 87019)	
CE 87019	Print Magnet	S/F	CE 11481 Print Magnet	NO		To permit print magnet to be adjusted	
CE 87020	End Bell	S/B	CE 87388	NO			To select fit for closer tolerance
CE 87020	End Bell	S/F	CE 11927 End Bell	NO			To provide new print magnet
CE 87027	Bracket Casting	S/F	CE 11045 Bracket Casting	YES			To change from magnesium to aluminum
CE 87028	Support	S/F	CE 11046 Support	YES			To change from magnesium to aluminum
CE 87029	Hub	S/F	CE 11061 Hub	YES			To change from magnesium to aluminum
CE 87032	Shell	M		YES			(See CE 87158)

304.13

Change No. 1

KAM-1/TSEC

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Part No.	Nomenclature	Action	Affected Part	Inter-change-able	Disposition	Reason For Change
CE 87038	Support	S/F	CE 11198 Support	YES		To change from magnesium to aluminum
CE 87039	Plate	S/F	CE 11298 Plate	YES		To change from magnesium to aluminum
CE 87041	Base	S/F	CE 14535 Base	YES		To change from magnesium to aluminum
CE 87043	Drawer	S/F	CE 14662 Drawer	YES		To change from magnesium to aluminum
CE 87044	Bracket, LH	S/F	CE 14646 Bracket, LH	YES		To change from magnesium to aluminum
CE 87044	Insulating Strip	A				To provide insulation on CE 87095 bottom cover
CE 87045	Bracket, RH	S/F	CE 14647 Bracket	YES		To change from magnesium to aluminum
CE 87046	Base	S/F	CE 14648 Base	YES		To change from magnesium to aluminum
CE 87047	Housing	S/F	CE 11467 Housing	YES		To change from magnesium to aluminum
CE 87048	Bracket, RH	S/F	CE 87262 Bracket	YES		To change from magnesium to aluminum
CE 87049	Base	S/F	CE 14504 Base	YES		To change from magnesium to aluminum
CE 87052	Test Base	S/F	CE 14717 Test Base	YES		To change from magnesium to aluminum

304.14

Change No. 1

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Inter-change-able	Disposition	Reason For Change
CE 87053	Rotor	S/B	CE 87383 Stator and End Bell	YES	Assemble at high echelon	To select fit for closer tolerances
CE 87055	Stator and Contact	S/B	CE 87383 Stator and End Bell	YES	Assemble at high echelon	To select fit for closer tolerances
CE 87056	Pulse Generator	S/F	CE 11288 Pulse Generator	YES		To change from magnesium to aluminum
CE 87058	Timing Unit	S/F	CE 11583 Timing Unit	YES		To change from magnesium to aluminum
CE 87059	Printer	S/F	CE 11566 Printer	YES		To change from magnesium to aluminum
CE 87060	End Bell and Tape Feed	S/B	CE 87383 Stator and End Bell	NO	Assemble at high echelon	To select fit for closer tolerance
CE 87061	Housing	S/F	CE 11721 Housing	YES		To change from magnesium to aluminum
CE 87062	Cam Switch and Trip Magnet	S/F	CE 11727 Cam Switch and Trip Magnet	YES		To change from magnesium to aluminum
CE 87062	Cam Switch and Trip Magnet	M		NO	Do not use	To dampen contact bounce
CE 87063	Shell	S/F	CE 87159 Shell	YES		To change from magnesium to aluminum
CE 87064	End Bell	S/B	CE 87373 Stator and End Bell	NO	Assemble at high echelon	To select fit for closer tolerance
CE 87066	AC Power Converter	S/F	CE 14563 AC Power Converter	YES		To change from magnesium to aluminum

304.15

Change No. 1

KAM-1/TS/SEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 87068	Stepping Unit	S/F	CE 14570 Stepping Unit	YES		To change from magnesium to aluminum
CE 87069	Cover	S/F	CE 87248 Cover	YES		To change from magnesium to aluminum
CE 87069	Cover	S/F	CE 11111 Carrying Case CE 87248 Cover	NO NO	Use Component Parts	To permit stocking as component parts
CE 87070	Case	S/F	CE 87247 Case	YES		To change from magnesium to aluminum
CE 87070	Carrying Case	S/F	CE 14630 Case	NO		
CE 87072	Drawer	S/F	CE 14661 Drawer	YES		To change from magnesium to aluminum
CE 87074	Cover	S/F	CE 14671 Cover	YES		To change from magnesium to aluminum
CE 87075	Accessories and Case	S/F	CE 14672 Accessories and Case	NO		
CE 87076	Case	S/F	CE 14676 Case	YES		To change from magnesium to aluminum
CE 87092	Insert	A				To secure rear end ball bearing position
CE 87095	Bottom Cover	S/F	CE 11675 Bottom Cover	NO		To protect KLA-7/TSEC
CE 87098	Retaining Ring	S/F	CE 11535 Retaining Ring	NO		(See CE 11949)
CE 87107	Flat Spring Clip	A				To prevent tape from buckling when torn off
CE 87130	Copy Holder	S/F	CE 14303 Copy Holder	NO		To provide better method for holding copy

304.16

Change No. 1

KAM-1/TSEC



~~CONFIDENTIAL~~

304.17

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 87181	Rivet	S/F	CE 11542 Rivet	NO		To prevent armature from "freezing"
CE 87136	Compression Spring	S/B	CE 54592 Compression Spring	NO	Do not use	(See CE 54592)
CE 87142	Seal Rubber	A				(See CE 87146)
CE 87146	Dzus Fastener	A				To provide means for holding cover on case top in reading position
CE 87147	Plate and Spring	A				CE 87146
CE 87148	Retaining Ring	A				(See CE 87146)
CE 87149	Fastener (Dzus)	A				(See CE 87146)
CE 87150	Name Plate	S/B	CE 88166 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 87151	Name Plate	S/B	CE 88157 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 87152	Name Plate	S/B	CE 88158 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 87153	Name Plate	S/B	CE 88159 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 87154	Name Plate	S/B	CE 88160 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 87155	Name Plate	S/B	CE 88161 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 87156	Name Plate	S/B	CE 88162 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 87156	Name Plate	S/F	CE 14682 Name Plate (Office Case)	NO		
CE 87157	Window	A				To protect KLK-7/TSEC against dust

~~CONFIDENTIAL~~

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 87158	Window Frame	A				To protect KLK-7/TSEC against dust
CE 87158	Window Frame	M				To provide slotted frame
CE 87159	Shell	S/F	CE 11864 Shell	NO		(See CE 87157)
CE 87159	Shell	S/B	CE 87063 Shell	YES	Interchange below # 4337	To change from magnesium to aluminum
CE 87161	Spring	A				(See CE 87146)
CE 87162	Spring Retaining Washer	A				(See CE 87146)
CE 87164	Tape Cover	A				(See CE 11408)
CE 87165	Ribbon Cover	A				To prevent unnecessary exposure of inked roller
CE 87171	Key	S/F	CE 11278 Key	NO		
CE 87173	Gear and Pinion	S/F	CE 11095 Gear and Pinion	NO		
CE 87176	Rotor	S/B	CE 87383 Stator and End Bell	NO	Assemble at high echelon	To select fit for closer tolerance
CE 87198	Rivet	A				To secure Name Plates
CE 87229	Spring	S/F	CE 11869 Spring	NO		To facilitate ribbon reversal
CE 87231	Eccentric	S/F	CE 11623 Eccentric	NO		(See CE 54571)
CE 87232	Pawl	S/F	CE 11696 Pawl	NO		To protect against dust
CE 87282	Pawl	S/F	CE 11095 Pawl	NO		

30418

Change No. 1

KAM-1/TSEC

CONFIDENTIAL

304.19

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Inter-changeable	Disposition	Reason For Change
CE 87233	Front Dust Cover	A				To protect against dust
CE 87237	Screw	A				(See CE 87157)
CE 87237	Screw	S/B	CE 87145 Rivet	NO	Continue using shells with screws	(See CE 87415)
CE 87237	Screw	S/B	CE 87415 Rivet	NO	Do not use	(See CE 87157)
CE 87243	Frame	S/F	CE 11068 Frame	NO		(See CE 87264)
CE 87243	Frame	S/B	CE 87244 Frame	YES	Interchange below #4337	To change from magnesium to aluminum
CE 87244	Frame	S/F	CE 87243 Frame	YES	Interchange below #4337	To change from magnesium to aluminum
CE 87247	Case	S/B	CE 87070 Case	YES	Interchange below #4337	To change from magnesium to aluminum
CE 87248	Cover	S/B	CE 87069 Case Cover	NO	Do not use	To change from magnesium to aluminum
CE 87248	Cover	S/F	CE 14616 Cover	NO		
CE 87251	Guide Plate	S/F	CE 11998 Guide Plate	NO		To assure pivoting instead of sliding action
CE 87252	Frame	S/F	CE 14465 Frame	NO		(See CE 14465)
CE 87256	Grommet	A				(See CE 87288)
CE 87261	Storage Plug	S/F	CE 14642 Storage Plug	NO		(See CE 87262)
CE 87261	Storage Plug	M				To provide better fit
CE 87261	Storage Plug	S/F	CE 14640 Storage Plug	NO		

CONFIDENTIAL

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 87262	Bracket	S/F	CE 14518 Bracket	YES		To provide for inclusion of line filter
CE 87262	Bracket, RH	S/B	CE 87048 Bracket, RH	YES	Interchange below #4337	To change from magnesium to aluminum
CE 87268	Guard Plate	A				(See CE 87264)
CE 87264	Plate and Contact, LH	S/F	CE 11144 Plate and Contact, LH	YES		To insure proper insertion of KLK-7/TSEC unit into KLA-7/TSEC
CE 87265	Key Chassis	S/F	CE 11350 Key Chassis	NO		To prevent keys from turning in chassis
CE 87266	Paper Storage	D			Do not use	To eliminate unnecessary item
CE 87267	Contact	S/F	CE 11064 Contact	NO		To provide heavier spring for K27 (FIG) key to prevent accidental closure
CE 87272	Seal, Space Bar	A				To protect space bar area from dust
CE 87279	Capacitor	S/F	CE 54546 Capacitor	NO		
CE 87281	Bushing	S/F	CE 54535 Bushing	NO		To prevent seizure of paper tape feed shaft by providing harder bushing
CE 87286	Key Switch	S/F	CE 54587 Key Switch	NO		To provide better dust protection
CE 87287	Washer	A				(See CE 87288)
CE 87288	Key Switch, RPT	S/F	CE 54536 Key Switch	NO		To provide dust protection for key switches
CE 87306	Name Plate	S/B	CE 88163 Plate Identification	NO	Do not use	To change to TSEC nomenclature

304.20

Change No. 1

KAM-1/TSEC

~~CONFIDENTIAL~~

30421

Change No. 1

Part No.	Nomenclature	Action	Affected Part	Inter-change-able	Disposition	Reason For Change
CE 87307	Decal	A				To provide instruction for removing operator's light
CE 87318	Light Shade	A				To provide better visibility
CE 87330	Time Shaft Clutch	S/F	CE 11133 Timing Shaft and CE 11176 Clutch	NO		To provide select fitted assy meeting tolerance requirements
CE 87347	Stud	A				To secure Name Plate
CE 87373	Spring Cup	A				(See CE 87318)
CE 87374	Screw	A				(See CE 87262)
CE 87376	Ball Bearing	A				(See CE 87380)
CE 87377	Setscrew	A				(See CE 87380)
CE 87378	Shaft Bearing	A				(See CE 87380)
CE 87379	Shaft Bearing	A				(See CE 87380)
CE 87380	Shaft	S/F	CE 14559 Shaft	NO		To improve mechanical action
CE 87383	Stator and End Bells	S/F	Component Parts	NO		To select fit for closer tolerances
CE 87415	Rivet	S/F	CE 87237 Screw	NO		To secure window frame
CE 87417	Shaft	S/F	CE 11443 Shaft	NO		To reduce eccentric wear
CE 87419	Motor-Generator			Continue to use		(See CE 88000)
CE 87419	Motor-Generator	S/F	CE 11014 Motor-Generator	YES		To change from magnesium to aluminum

~~CONFIDENTIAL~~

KAM-1/TSEC

CONFIDENTIAL

CONFIDENTIAL

Part No.	Nomenclature	Action	Affected Part	Interchangeable	Disposition	Reason For Change
CE 87420	Motor-Generator and Controller	S/F	CE 11013 Motor-Generator and Controller	YES		To change from magnesium to aluminum
CE 87420	Motor-Generator and Controller	S/B	CE 88000 Motor-Generator and Controller	YES	Interchange as a complete Assembly	(See CE 88000)
CE 87422	Line Filter	A				To minimize radio interference
CE 87444	Lock Washer	A				(See CE 87422)
CE 87446	Screw	S/F	CE 11855 Screw	NO		(See CE 87447)
CE 87447	Screw	S/F	CE 11841 Screw	NO		To permit wider adjustment of switches
CE 87453	Canopy	S/F	CE 11573 Canopy	YES		(See CE 87454)
CE 87454	Lamp Socket	S/F	CE 11571 Lamp Socket	YES		To reduce light radiation
CE 87465	Paper Container	S/F	CE 11408 Paper Container	NO		To provide better weather protection
CE 87471	Link	S/F	CE 11224 Link	NO		To provide more clearance between Link and KLA-7/TSEC frame
CE 88000	Motor-Generator and Controller Box Assy	S/F	CE 87420 Motor-Generator and Controller	YES		To provide more constant speed
CE 88124	Capacitor	S/F	CE 11987 Capacitor	NO		To dampen oscillations in print circuit
CE 88142	Name Plate	S/B	CE 88142 Name Plate	NO	Do not use	To change to TSEC nomenclature
CE 88144	Cable Clamp	A				(See CE 87422)
CE 88146	Screw	S/F	CE 11011 Screw	NO		To make rotor stepping magnet more secure

304.22

Change No. 1

KAM-1/TSEC

~~CONFIDENTIAL~~

304.23

Change No. 1  
Reverse (Page 304.24) Blank  
42-NAV-56-43-6052

Part No.	Nomenclature	Action	Affected Part	Inter-change-able	Disposition	Reason For Change
CE 88150	Retaining Ring	S/F	CE 11762 Retaining Ring	NO		(See CE 54592)
CE 88154	Jacket	A				To prevent burning of contact board
CE 88156	Plate Identification	S/F	CE 87150 and/or CE 11952 Name Plate	NO		To change to TSEC nomenclature
CE 88157	Plate Identification	S/F	CE 87151 and/or CE 11994 Name Plate	NO		To change to TSEC nomenclature
CE 88158	Plate Identification	S/F	CE 87152 and/or CE 14561 Name Plate	NO		To change to TSEC nomenclature
CE 88159	Plate Identification	S/F	CE 87158 and/or CE 14608 Name Plate	NO		To change to TSEC nomenclature
CE 88160	Plate Identification	S/F	CE 87154 and/or CE 14328 Name Plate	NO		To change to TSEC nomenclature
CE 88161	Plate Identification	S/F	CE 87155 and/or CE 14829 Name Plate	NO		To change to TSEC nomenclature
CE 88162	Plate Identification	S/F	CE 87156 Name Plate	NO		To change to TSEC nomenclature
CE 88163	Plate Identification	S/F	CE 87306 Name Plate	NO		To change to TSEC nomenclature
CE 88164	Plate Identification	S/F	CE 88142 Name Plate	NO		To change to TSEC nomenclature
CE 88165	Spacer	A				To protect fuse from corrosion
CE 88166	Fuse Post	S/F	CE 11806 Fuse Holder	NO		To protect fuse from corrosion
CE 88167	Nut	S/F	CE 11311 Nut	NO		(See CE 88166)
CE 88169	Lock Washer	S/F	CE 54548 Lock Washer	NO		(See CE 88166)

~~CONFIDENTIAL~~

KAM-1/TSEC

APPENDIX C

REPLACEABLE PARTS FOR DEVICES USED WITH THE TSEC/KL-7

1. KLX-7/TSEC.—The following list includes replaceable components for the CE 88272 adapter assembly and the CE 88227 adapter cable assembly (The KLX-7/TSEC). All parts are shown in figure 66. Any part listed below may be ordered in accordance with instructions contained in Chapter 9.

Part Number	Description of Part	Quan. Used	Used On
CE 11387	Ring, Retaining: Beryllium.....	1	CE 88272
CE 11821	Nut: hex, stl, #6-32.....	1	CE 88227
CE 11841	Screw: stl, cad, pl, black dip; FH, csk, hex socket drive; #6-32 x 1/2" loa.....	1	CE 88227
CE 88202	Adapter Plate.....	1	CE 88272
CE 88205	Contact Subassembly: 1/4" lg; 3/16" OD.....	30	CE 88202
CE 88208	Spacer: brass; 1/4" OD; 1/8" ID; 1/16" thk.....	1	CE 88202
CE 88209	Terminal: mill tinned copper, 1/2" lg.....	1	CE 88202
CE 88212	Washer, Lock: flat, round, CS.....	8	CE 88272
CE 88213	Crank.....	1	CE 88272
CE 88218	Washer, Flat: round.....	8	CE 88272
CE 88220	Cover.....	1	CE 88272
CE 88222	Screw: binding head; cad, pl, black dip; #4-40 x 0.375" lg; common steel.....	2	CE 88272
CE 88223	Washer, Lock: round; CS, external teeth.....	2	CE 88272
CE 88226	Contact S/A: 3/4" lg; 1/2" OD.....	3	CE 88202
CE 88227	Adapter, Cable Assembly.....	1	Main
CE 88228	Connector, Cannon: 2 1/4" lg x 2 3/4" w.....	1	CE 88227
CE 88229	Cover: 3" lg x 1 1/4" w.....	1	CE 88227
CE 88235	Screw: stl, cad, pl, black dip; binding head; #4-40 x 3/8" loa.....	2	CE 88227
CE 88236	Wire Harness, Cable: 37 conductor; 1/8" OD.....	1	CE 88227
CE 88238	Clamp: nylon, 1" lg x 1/2" w.....	1	CE 88227
CE 88239	Clamp: nylon, 1" lg x 1/4" w.....	1	CE 88227
CE 88240	Cover, Assembly: 6 1/4" lg x 3 3/4" w.....	1	CE 88227
CE 88241	Plug.....	1	CE 88227
CE 88245	Plug.....	1	CE 88227
CE 88247	Plate Cover: 9" lg x 2 1/4" w.....	1	CE 88272
CE 88254	Screw: socket head cap; #2-56 x 1/8" loa, stl, cad, pl, black dip.....	8	CE 88272
CE 88255	Cover S/A: stl.....	1	CE 88240
CE 88259	Plunger: SST, 2 3/4" lg x 2" w.....	2	CE 88240
CE 88260	Bail: SST; 3 1/2" lg x 2 1/8" h x 1/2" w.....	1	CE 88240
CE 88261	Clamp: stl.....	2	CE 88227
CE 88262	Screw: stl, cad, pl, FH, #6-40 x 1/16" loa.....	2	CE 88227
CE 88263	Stud: SST; #6-40 x 1 1/2" loa.....	2	CE 88240
CE 88264	Spacer: SST; 1/16" OD, 0.191" ID, 0.040" thk.....	2	CE 88240
CE 88266	Screw, Drive: stl.....	2	CE 88272
CE 88267	Plate, Identification: aluminum; 3" lg x 1/2" w; 2 mtg holes.....	1	CE 88272
CE 88268	Stud: stl, #8-32 x 1 1/2" loa; 3/8" OD; 1/4" ID.....	5	CE 88272
CE 88272	Adapter Assembly.....	1	Main
CE 128609	Cord Assembly, Electrical: w/alligator clip; 2 conductor; braided tinned copper shield.....	1	CE 88227
FSN-5315-392-0151	Pin, Drive: stl, 1 1/2" lg; 1/8" diameter.....	4	CE 88227



~~CONFIDENTIAL~~

KAM-1/TSEC

Part Number	Description of Part	Quan. Used	Used On
FSN-5935-201-2414	Connector, Plug, Electrical: 2 prong, rubber covered; 15 amps—125 v, and 10 amps—250 v.....	1	CE 128609
FSN-5940-392-1384	Clip, Electrical: alligator.....	1	CE 128609
FSN-5970-392-1383	Insulation, Sleeving, Electrical.....	1	CE 128609

2. Vehicle Mounting Assembly.—The following list includes replaceable components for the CE 87275 vehicle mounting assembly. Any part listed below may be obtained through normal Service Channels.

Part Number	Description of Part	Quan. Used
CE 87308	Mounting Plate Assembly.....	1
CE 87354	Terminal Box Assembly.....	1
CE 87355	Cable Accessory Assembly.....	1
CE 87356	Connector.....	1
CE 87357	Stuffing Tube.....	1
CE 87358	Cable.....	1
CE 87359	Mounting Assembly.....	1
CE 87363	Cable Clamp Package Includes following parts:	1
	CE 14440 Lock Washer.....	6
	CE 87353 Loop Clamp.....	6
	CE 87361 Bushing.....	6
	CE 87363 Screw.....	6
CE 87418	Mounting Strip.....	2

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

## INDEX

## A

Subject	Paragraph	Page
Abbreviations, List of.....	9005	164
Accessories and Case Assembly: Description of.....	2102i	17
AC Power Converter: (See Power Converter, AC).....	5310	94
Actuator Switches: Circuitry.....	5404	99
Clearance Adjustment.....	6208	108
Adjustments, Chapter 6.....		105-118

## B

Base Assembly: Cleaning of.....	7814	135
Description of.....	2102a	18
Function of.....	4002	33
Lubrication of.....	7403	136

## C

Carrying Case Assembly.....	2102h	17
Charge Cam Switch, function of.....	2103o	19
Checking procedure for maintenance personnel.....	8000	145
General.....	8001	145
Packing Procedures.....	8003	145
Transporting TSEC/KL-7 on Packboard.....	8004	146
Trouble-shooting Data.....	8002	145
Vehicle Mounting Kit.....	8005	146
Cipher unit: Adjustment of.....	6100	106
General.....	6101	106
Plunger Contact Spring Tension.....	6102	106

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Rotor Plunger Spring Tension.....	6103 .....	106
Cleaning of.....	7303 .....	126
Description of.....	2102f .....	18
Lubrication of.....	7409 .....	143
Operator's Cleaning Procedures.....	7108a .....	121
Circuits, Chapter 5:		
Classification of.....	5001 .....	69
Circuit Data; Tables.....	5501 .....	102
Circuits, General:		
Circuit Tracing Aids.....	5002 .....	69
Description of Circuits.....	5001 .....	69
Circuit Tracing Aids.....	5002 .....	69
Classification of Circuits.....	5001 .....	69
Cleaning and Lubrication, Chapter 7.....		119-143
General Information.....	7000 .....	119
Procedures for Operating Personnel.....	7100 .....	120
Flat Head and Pressure Contacts.....	7102 .....	121
General Instructions.....	7101 .....	120
Procedures.....	7108 .....	121
Reassembly Instructions.....	7104 .....	122
Cleaning Procedures for Maintenance Personnel:		
Base Assembly.....	7300 .....	126
Cipher Unit.....	7314 .....	135
Contact Panel Assembly.....	7303 .....	126
Crankshaft Assembly.....	7313 .....	134
Front End Bell Cover Assembly and Attached Parts.....	7310 .....	134
General.....	7306 .....	130
Keyboard Assembly.....	7301 .....	126
Motor-Generator and Controller Assembly.....	7311 .....	134
Preparation for Cleaning.....	7308 .....	132
Printer Unit.....	7302 .....	126
Pulse Generator Assembly.....	7305 .....	129
Rotor Stepping Unit.....	7307 .....	130
Sliding Contact Board and Guide Rail Assembly.....	7304 .....	127
Timing Unit.....	7312 .....	134
.....	7309 .....	132
Clutch Pawl Spring Tension.....	6307 .....	111
Comments or Recommendations.....	1002 .....	15
Common Circuit.....	5308 .....	94
Common Parts by Types.....	9101 .....	279

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Common Return.....	4114	64
Component Assemblies, TSEC/KL-7.....	2101	18
Contact Panel Assembly:		
Cleaning of.....	7318	134
Description of.....	2102c	18
Diagram of.....	8002d	145
Function of.....	4005	85
Lubrication of.....	7404	136
Operators Cleaning of.....	7103f	121
Contact Panel Follower Spring Tension.....	6502	118
Contact Panel Pressure Contact Compression.....	6501	118
Crankshaft Assembly:		
Assembly of.....	7407a	137
Cleaning of.....	7310	134
Lubrication of.....	7407a	137
Crankshaft Miter Gear Backlash Adjustment.....	6302	110
<b>D</b>		
Description TSEC/KL-7:.....	2100	18
Component Assemblies.....	2102	18
General Function.....	2103	19
Size, Weight, and Power Requirements.....	2101	18
Timing Cycle.....	2104	21
Detent Ratchet Pawl Spring Tension.....	6316	112
Disposal of Worn and/or Defective Parts.....	9003	164
Double-drive Ratchet Pawl:		
Adjustment of.....	6321	113
Spring Tension.....	6319	113
Double-drive Ratchet Spring Compression.....	6317	112
Drive Link Spring Tension.....	6301	110
Drive Pawl Effective Length Adjustment.....	6207	107
Drive Pawl Spring Tension.....	6201	107

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Dust Covers, installation of.....	7407g	137
 <b>E</b> 		
Effective Pages, List of.....		3
Electronic Circuits.....	4107	56
Electronic Theory:.....	4100	51
CE 87066 Power Converter.....	4113	63
Common.....	4114	64
Electronic Circuits.....	4107	56
Gate Tube, V104.....	4109	57
General.....	4101	51
High-voltage Supply.....	4116	64
Key Circuit, E Operation.....	4104	53
Key Circuit, D Operation.....	4105	53
Key Circuit, P Operation.....	4108	52
Low-voltage Supply.....	4115	64
Print Tube, V101.....	4110	59
Power Circuit.....	4112	63
Rotor Stepping Magnet Circuits.....	4117	65
Sharpener Tube, V102.....	4108	56
Shift Tube, V103.....	4111	61
Sliding Contact Board and Guide Rail Assembly.....	4102	51
Special Key Circuits.....	4106	54
Emergency Repair.....	9004	164
Employment, Chapter 3.....		
 <b>F</b> 		
Feed Roll Follower Spring Tension.....	6322	113
Figures Cam Switch:		
Adjustment of.....	6305	110
Function of.....	2103o	19
Figured Wheel Adjustment.....	6336	115
Fixed Connections.....	5402	97
Front End Bell Cover Assembly and Attached Parts:		
Assembly of.....	7407e	136
Cleaning of.....	7306	180
Lubrication of.....	7407e	136
Function Selector Handle (See Selector Handle).....	6406	117

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Full-wave Rectifier:		
Circuitry.....	5804	91
Function of.....	5801c	90

G

Gate Tube V104:		
Circuitry.....	5205	86
Description of.....	5201d	79
Function of.....	2103a	17
Theory.....	4109	57
General Function, TSEC/KL-7.....	2103	19
General Information, TSEC/KL-7.....	2001	17
General Information for Maintenance Personnel.....	7200	124
General Maintenance Checks.....	7410	143
Generator Output Voltage.....	6335	115
Guide Rail Assembly:		
Function of.....	4004b	34
Lubrication of.....	7812	134

H

High-voltage Supply.....	4116	64
Hold-down Spring Tension.....	6204	107

I

Identifying Parts.....	9001	163
Illustrations, List of.....		13
Input Circuit:		
Circuitry.....	5302	90
Function of.....	5301a	90
Inspection Procedure and Damage Report.....	3002	23

~~CONFIDENTIAL~~

ORIGINAL

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Installation of Equipment.....	3003 .....	23
Interchangeability of Superseded Part Numbers. App B.....		303
Introduction and Description, Chapter 2.....		17
Introduction.....	2000 .....	17
Classification of Parts.....	2002 .....	17
General.....	2001 .....	17
Safeguarding of Equipment.....	2003 .....	17
Isolated 220-volt Supply:		
Circuitry.....	5306 .....	93
Function of.....	5301e .....	90

K

Keyboard Assembly:		
Adjustment of.....	6400 .....	117
Key Switch Spring Compression.....	6401 .....	117
Power Switch Leaf Tension.....	6404 .....	117
RPT Key Switch Spring Compression.....	6402 .....	117
Selector Handle Detent Action.....	6406 .....	117
Space Bar Pressure Contact Compression.....	6405 .....	117
Space Bar Spring Tension.....	6403 .....	117
Assembly of.....	7406e .....	186
Cleaning of.....	7311 .....	134
Description of.....	2102b .....	18
Function of.....	4003a .....	33
Lubrication of.....	7406 .....	186
Multi-circuit Switching Function.....	4003c .....	33
Operator's Cleaning of.....	7103e .....	121
Power Input Function.....	4003b .....	33

Key Circuits:		
Definition of.....	5101b .....	70
Description.....	4101a .....	51
D Operation.....	4105 .....	53
E Operation.....	4104 .....	53
General.....	5101 .....	70
Normal Key Circuits.....	5102 .....	70
P Operation.....	4103 .....	52
Purpose of.....	5001a .....	69
Special Key Circuits.....	5103 .....	71

Key Switches:		
Adjustment of.....	6401 .....	117
Cleaning of.....	7311f .....	134
Description of.....	2102b .....	18
Function of.....	4003a .....	33
Lubrication of.....	7406c .....	186

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Key Switch Spring Compression.....	6401	117
L		
Letter of Promulgation.....		2
Letters Cam Switch:		
Adjustment of.....	6305	110
Cleaning of.....	7309	132
Function of.....	2103o	19
List of Abbreviations.....	9005	164
List of Effective Pages.....		3
List of Illustrations.....		13
List of Recommended Tools.....		301
Low-voltage Supply.....	4115	64
Lubrication and Cleaning, Chapter 7.....		
Lubricants.....	7402	136
Lubricating Procedures for Maintenance Personnel:.....	7400	136
Base Assembly.....	7403	136
Cipher Unit.....	7409	143
Contact Panel Assembly.....	7404	136
General.....	7401	136
General Maintenance Checks.....	7410	143
Keyboard Assembly.....	7406	136
Lubricants.....	7402	136
Printer Assembly.....	7407	137
Rotor Stepping Unit.....	7408	142
Sliding Contact Board and Guide Rail Assembly.....	7405	136
M		
Mechanical Adjustments:.....	6000	105
Cipher Unit.....	6100	105
Keyboard Assembly.....	6400	117
Panel and Base Assembly.....	6500	118
Printer Unit.....	6800	110
Rotor Stepping Unit.....	6200	107

~~CONFIDENTIAL~~



~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Mechanical Adjustments, Procedure.....	6001 .....	105
Motor Generator and Controller Assembly:		
Adjustment of.....	6830 .....	114
Circuitry.....	5803 .....	91
Cleaning of.....	7308 .....	182
Function of.....	5801b .....	90
Installation and Lubrication of.....	7407c .....	187
Theory.....	4006a .....	36
Motor Generator and Controller Pressure Contact Alignment.....	6833 .....	115
Motor Generator and Controller Pressure Contact Compression.....	6832 .....	115
Motor Generator Brush Spring Tension.....	6381 .....	115
Motor Generator Speed Adjustment.....	6334 .....	115
Mounting Assembly, Vehicle.....	8005b .....	146
Mounting Kit, Vehicle.....	8005 .....	146
Mounting Kit, Vehicle, Replaceable Components.....	App C .....	805
Mounting Plate, Vehicle.....	8005a .....	146
N		
No-Back Pawl:		
Adjustment of.....	6320 .....	113
Spring Tension.....	6314 .....	112
No-Back Pawl Spring Tension.....	6314 .....	112
Normal Key Circuits.....	5102 .....	70
Numerical Parts List.....	9102 .....	285
Negative 72-volt Bias Supply:		
Circuitry.....	5307 .....	93
Function of.....	5301f .....	90

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
O		
Office Case Assembly.....	2102d	18
Operational and Functional Errors.....	8005	27
Operation of TSEC/KL-7 in the Office Case.....	3005	27
Operator's Light Socket Pressure Contact Compression.....	6504	118
Operator's Procedures, Cleaning and Reassembly (See Procedures for Operating Personnel (7100)).....		121
Ordering Parts.....	9002	168
P		
Packing Procedure.....	8008	145
Panel and Base Assembly:		
Adjustment of.....	6500	118
Contact Panel Follower Spring Tension.....	6502	118
Contact Panel Pressure Contact Compression.....	6501	118
Operator's Light Socket Pressure Contact Compression.....	6504	118
Stop Pin Spring Tension.....	6503	118
Paper Tape, Installation of.....	3008d	28
Paper Tape Feed Mechanism:		
Adjustment of.....	6313	112
Cleaning of.....	7305	129
Function of.....	4006d	36
Parts:		
Classification of.....	2002	17
List of Replacement.....	9100	279
Numerical List of.....	9102	285
Parts Identification Illustration.....	8002g	145
Physical Description and Mechanical Theory:		
Base.....	4002	38
Contact Panel Assembly.....	4005	36
General.....	4001	39
Keyboard Assembly.....	4008	33
Printer Assembly.....	4006	36

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Rotor Stepping Unit.....	4007	46
Sliding Contact Board and Guide Rail Assembly.....	4004	84
Plunger Contact Spring Tension.....	6102	106
Positioning Arm Spring Tension.....	6203	107
Power Circuit, TSEC/KL-7:.....	5300	90
AC Power Converter.....	5310	94
Common Circuit.....	5308	94
Description.....	4101c	51
Full-wave Rectifier.....	5304	
General.....	5301	90
Input Circuit.....	5302	90
Isolated 220-volt Supply.....	5306	93
Motor-Generator and Controller Circuit.....	5303	91
Negative 72-volt Bias Supply.....	5307	93
Purpose of.....	5001c	69
Tube Filament Circuit.....	5309	94
Unisolated 200-volt Supply.....	5306	92
Power Converter, AC:		
Description of.....	2102g	18
Circuitry.....	5310	94
Power Converter, CE 87066.....	4113	63
Power Supply, Connecting of.....	3003e	23
Power Switch Leaf Tension.....	6404	117
Preparation for Cleaning.....	7302	126
Preparation for Use, TSEC/KL-7:.....	3000	23
Inspection Procedure and Damage Report.....	3002	23
Installation of Equipment.....	3003	23
Operational and Functional Errors.....	3005	27
Operation of TSEC/KL-7 in the Office Case.....	3005	27
Test Procedures.....	3004	25
Unpacking Procedure.....	3001	23
Printing Mechanism, Function of.....	2103ms	21
Print Magnet:		
Adjustment of.....	6326	114
Cleaning of.....	7305b	129
Print Magnet Eccentric Adjustment.....	6329	114
Print Magnet Pressure Contact Spring Compression.....	6327	114

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Print Magnet Reed Spring Tension.....	6328	114
Printer Assembly (See also Printer Unit):		
Adjustment of.....	6300	110
Cleaning of.....	7305	129
Counter Operation, Theory.....	4007d	46
Crankshaft and Drive, Link Assemblies.....	4006f	36
Description of.....	2102d	18
Function of.....	4006	36
Gear Housing, Composition and Theory.....	4006e	36
General Function.....	2102d	18
Lubrication of.....	7407	137
Operator's Cleaning of.....	7103d	121
Pulse Generator and Associated Parts, Theory.....	4006b	36
Ribbon Reversing Mechanism, Theory.....	4006c	36
Paper tape Feed Mechanism, Theory.....	4006d	36
Timing Unit, Theory.....	4006g	36
Printer Unit (See also Printer Assembly):		
Adjustment of.....	6300	110
Brush Spring Tension.....	6331	115
Clutch Pawl Spring Tension.....	7307	130
Crankshaft Miter Gear Backlash Adjustment.....	6302	110
Detent Ratchet Pawl Spring Tension.....	6316	112
Double-drive Ratchet Pawl Adjustment.....	6321	113
Double-drive Ratchet Pawl Spring Tension.....	6319	113
Double-drive Ratchet Spring Compression.....	6317	112
Drive Link Spring Tension.....	6301	110
Feed Roll Follower Spring Tension.....	6322	113
Figured Wheel Adjustment.....	6336	115
Generator Output Voltage.....	6335	115
Motor-Generator and Controller Adjustments.....	6330	114
Motor-Generator and Controller Pressure Contact Alignment.....	6333	115
Motor-Generator and Controller Pressure Contact Compression.....	6332	115
Motor-Generator Speed Adjustment.....	6334	115
No-back Pawl Adjustment.....	6320	113
No-back Pawl Spring Tension.....	6314	112
Print Magnet Adjustments.....	6326	114
Print Magnet Eccentric Adjustment.....	6329	114
Print Magnet Pressure Contact Spring Compression.....	6327	114
Print Magnet Reed Spring Tension.....	6323	114
Pulse Generator Pressure Contact Compression.....	6312	112
Ribbon Reversing Mechanism Adjustment.....	6323	114
Ribbon Spool Compression Spring Tension.....	6325	114
Shifting Lever Spring Tension.....	6324	114
Single-drive Ratchet Pawl Spring Tension.....	6316	112
Stop Pawl Spring Tension.....	6318	112
Tape Feed Mechanism Adjustments.....	6313	112
Timing Unit Adjustments.....	6303	110
Timing Unit Cam Switch Adjustments.....	6305	110
Timing Unit Detent Pawl Adjustment.....	6311	112
Timing Unit Detent Pawl Spring Tension.....	6306	111
Timing Unit Pressure Contact Compression.....	6304	110
Trip Magnet Armature Gap Adjustment.....	6310	111
Trip Magnet Armature Spring Tension.....	6308	111
Trip Magnet Position Adjustment.....	6309	111
Cleaning of.....	7305	129

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Print Tube V101:		
Circuitry .....	5202 .....	79
Description of .....	5201a .....	79
Function of .....	4110 .....	59
Purpose of .....	2108 .....	19
Procedures for Operating Personnel:	7100 .....	120
Flat Head and Pressure Contacts .....	7102 .....	121
Frequency .....	7101b .....	120
General Instructions .....	7101 .....	120
Limitations .....	7101a .....	120
Procedures .....	7103 .....	121
Reassembly Instructions .....	7104 .....	122
Tools and Materials .....	7101c .....	120
Promulgation, Letter of .....		2
Pulse Generator Assembly:		
Assembly of .....	7407d .....	137
Cleaning of .....	7807 .....	130
Function of .....	2103b .....	19
Lubrication of .....	7407d .....	130
Pulse Generator Pressure Contact Compression .....	6812 .....	112
R		
Recommended Tools, List of .....	App A .....	301
Record of Corrections .....		5
Reentry Circuits .....	5403 .....	99
Repeat Cam Switch:		
Adjustment of .....	6305 .....	110
Cleaning of .....	7309 .....	132
Function of .....	2103e .....	19
Repeat Function, Theory .....	4110f .....	59
Repeat Key Switch Spring Compression .....	6402 .....	117
Replacement Parts, Chapter 9:		
Disposal of Worn and/or Defective Parts .....	9003 .....	164
Emergency Repair .....	9004 .....	164
Identifying Parts .....	9001 .....	163
List of Abbreviations .....	9005 .....	164
Ordering Parts .....	9002 .....	163

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Replacement Parts, List of:.....	9100	279
List of Common Parts of Types.....	9101	279
Numerical Lists of Parts.....	9102	295
 Ribbon Reversing Mechanism:		
Adjustment of.....	6323	114
Assembly of.....	7407e	137
Cleaning of.....	7805	129
Function of.....	4006c	36
Lubrication of.....	7407e	137
 Ribbon Spool Compression Spring Tension.....	6325	114
 Rotor Plunger Spring Tension.....	6108	106
 Rotors:		
Assembly of.....	7409a	143
Cleaning of.....	3003a	23
Function of.....	2103c	16
Lubrication of.....	3003a	23
Operator's Cleaning of.....	7103c	121
Placement of.....	3003b	23
 Rotor Stepping Circuits:		
Rotor Stepping Unit.....	5400	97
Fixed Connections.....	5402	97
Actuator Switches.....	5404	99
Reentry Circuits.....	5403	99
Function of.....	4117	65
Purpose of.....	5001d	69
Rotor Stepping.....	4117d	65
Theory.....	4101d	51
 Rotor Stepping Unit:		
Adjustment of.....	6200	107
Cleaning of.....	7804	127
Description of.....	2102e	19
Function of.....	4007	46
Lubrication of.....	7408	141
Mechanical Function, E and D Position.....	4007c	46
Mechanical Function, P Position.....	4007b	46
Reentry Circuits.....	5403	99

S

Safeguarding of Equipment.....	2003	17
 Schematic and Wiring Diagrams.....	8002f	145
 Selector Handle Assembly:		
Adjustment of.....	6406	117

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Assembly of.....	7406d.....	136
Lubrication of.....	7406a.....	136
Selector Handle Detent Action.....	6406.....	117
Service Guide, Chapter 8.....		145
Sharpener Tube V102:		
Circuitry.....	5203.....	84
Description of.....	5201b.....	79
Function of.....	2103f.....	21
Theory.....	4108.....	56
Shifting Lever Spring Tension.....	6324.....	114
Shift Tube, V103:		
Circuitry.....	5203.....	84
Description of.....	5201c.....	79
Function of.....	2103k.....	21
Theory.....	4111.....	61
Simplified Trouble-shooting Chart.....	3101.....	28
Single-drive Ratchet Pawl Spring Tension.....	6315.....	112
Size, Weight, and Power Requirements.....	2101.....	18
Sliding Contact Board and Guide Rail Assembly:		
Assembly of.....	7406e.....	136
Cleaning of.....	7312.....	134
Description of.....	2103a.....	19
Double T Contacts Theory.....	4004a.....	34
Follower Actuating Cam, Function of.....	4004c.....	34
Function of.....	4102.....	51
Lubrication of.....	7405.....	136
Operator's Cleaning of.....	7103e.....	121
T and Connecting Bar Contacts Theory.....	4004a.....	34
Space Bar Pressure Contact Compression.....	6405.....	117
Space Bar Spring Tension.....	6403.....	117
Special Key Circuits:		
Circuitry.....	5103.....	71
Figure Key Circuit.....	5103b.....	71
Letters Key Circuit.....	5103c.....	71
Repeat Key Circuit.....	5103a.....	71
Space Bar Circuit.....	5103d.....	71
V, J, and Z Circuits.....	5103e.....	71
Theory of.....	4106.....	54

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Stepping Magnet Armature Spring Tension.....	6205	107
Stepping Magnet Position Adjustment.....	6206	107
Stepping Unit Assembly, Operator's Cleaning of.....	7103b	121
Stop Assembly Spring Tension.....	6202	107
Stop Pawl Spring Tension.....	6318	112
Stop Pin Spring Tension.....	6503	117

## T

Table of Contents.....		7
Table 1, Capacitors.....		102
Table 5, Current Requirements.....		104
Table 3, Diodes.....		103
Table 6, JAN Wire Color Code.....		104
Table 4, Miscellaneous Electrical Components.....		108
Table 2, Resistors.....		102
Tables, Circuit Data.....	5501	102
Tape Feed Mechanism Adjustments.....	6313	112
Terminal Box Assembly (Vehicle Mounting).....	8005c	146
Test Procedure.....	3004	25
Theory, Chapter 4.....		33
Timing Cycle, TSEC/KL-7.....	2104	21

~~CONFIDENTIAL~~

ORIGINAL



~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Timing Unit:		
Adjustment of.....	6308	110
Cleaning of.....	7309	132
Installation of.....	7407b	137
Lubrication of.....	7407b	137
Timing Unit Cam Switch Adjustments.....	6305	110
Timing Unit Detent Pawl Adjustment.....	6311	112
Timing Unit Detent Pawl Spring Tension.....	6306	111
Timing Unit Pressure Contact Compression.....	6304	110
Title Page.....		1
Tools and Materials:		
For Maintenance Personnel.....	7201e	124
For Operating Personnel.....	7101c	120
Transporting TSEC/KL-7 on Packboard.....	8004	146
Trip Magnet Armature Gap Adjustment.....	6310	111
Trip Magnet Armature Spring Tension.....	6308	111
Trip Magnet Position Adjustment.....	6309	111
Trouble-shooting Chart No. 1.....	8002a	145
Trouble Shooting.....	3100	23
Trouble-shooting Charts.....	8101	148
Trouble Shooting TSEC/KL-7.....	8101a	148
Trouble Shooting TSEC/KL-7 with the Oscilloscope.....	8101b	148
Typical Voltage Readings.....	8101c	148
Trouble-shooting Data.....	8002	145
Complete Schematic and Wiring Diagrams.....	8002f	145
Contact Panel Assembly Diagrams.....	8002d	145
Parts Identification Illustrations.....	8002g	145
Chart No. 1, Trouble Shooting TSEC/KL-7.....	8002a	145
Chart No. 2, Trouble Shooting TSEC/KL-7 with the Oscilloscope.....	8002b	145
Chart No. 3, Typical Voltage Readings.....	8002c	145
Voltage and Resistance Chart for Tube Socket Terminals.....	8002e	145
Trouble Shooting TSEC/KL-7, Chart No. 1.....	8101a	148

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1/TSEC

Subject	Paragraph	Page
Trouble Shooting with the Oscilloscope, Chart No. 2.....	8101b .....	148
Tube Circuits:		
Gate Tube, V104.....	5205 .....	86
General.....	5201 .....	79
Print Tube, V101.....	5202 .....	79
Sharpener Tube, V102.....	5203 .....	84
Shift Tube, V108.....	5204 .....	85
Tube Circuits:		
Description.....	4101b .....	51
Purpose of.....	5001b .....	69
Tube Filament Circuit.....	5309 .....	94
Tube Filaments, Function of.....	5301g .....	90
Tube Functions.....	5201 .....	79
Typewriter Ribbon, Installation of.....	3008c .....	23
Typical Voltage Readings, Chart No. 3.....	8101c .....	148

U

Unisolated 220-volt Supply		
Circuitry.....	5905 .....	92
Function of.....	5301d .....	90
Unpacking Procedures.....	3001 .....	23

V

Vehicle Mounting Assembly.....	App C .....	305
Vehicle Mounting Kit.....		
Electrical Elements.....	8005 .....	146
Mounting Assembly.....	8005d .....	146
Mounting Plate.....	8005b .....	146
Terminal Box Assembly.....	8005a .....	146
Terminal Box Assembly.....	8005c .....	146
Voltage and Resistance Chart for Tube Socket Terminals.....	8002e .....	145

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

KAM-1-1981

~~CONFIDENTIAL~~

ORIGINAL  
(Reverse Bank)