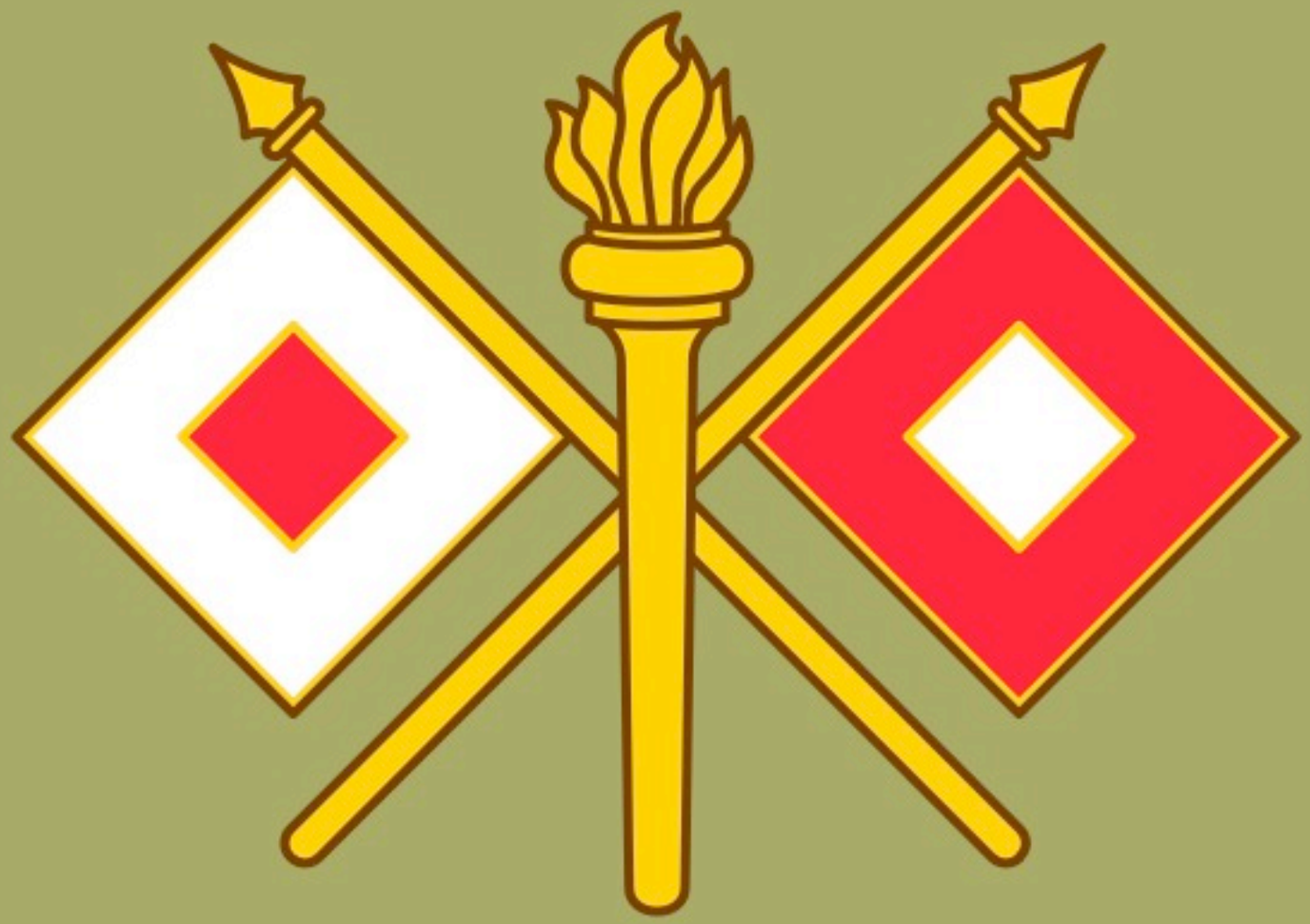
CONVERTER M-209-B



MARK J. BLAIR, NF6X

MAY 1, 2009

INTRODUCTION

- Description
- History
- Operation
- Q&A
- Demonstration

DESCRIPTION

- Mechanical cipher machine
- Prints plaintext/ciphertext on paper tape
- Light and compact, usable in the field
- No electricity needed
- Simple to operate once keyed

DESCRIPTION

DESCRIPTION

HISTORY

- Model C-35 Hagelin Cryptograph invented by Swedish cryptographer Boris Hagelin around 1934-1935
- Improved models C-36 and C-38 followed
- Hagelin promoted his machines to U.S. government in 1940
- U.S. licensed C-38 with minor modifications, called it Converter M-209

HISTORY

- Over 140,000 machines produced during World War 2 by many companies
- Several versions with minor production variations, including M-209, M-209-A, M-209-B and CSP-1500 (Navy version)
- Used for encryption of low-level tactical traffic throughout World War 2 and the Korean War

OPERATION

- Machine must first be programmed with proper key... more on this later
- Operator sets machine to Cipher or Decipher mode
- Operator dials in each letter with setting knob on left, then turns drive knob on right
- Machine prints each enciphered or deciphered letter on paper tape

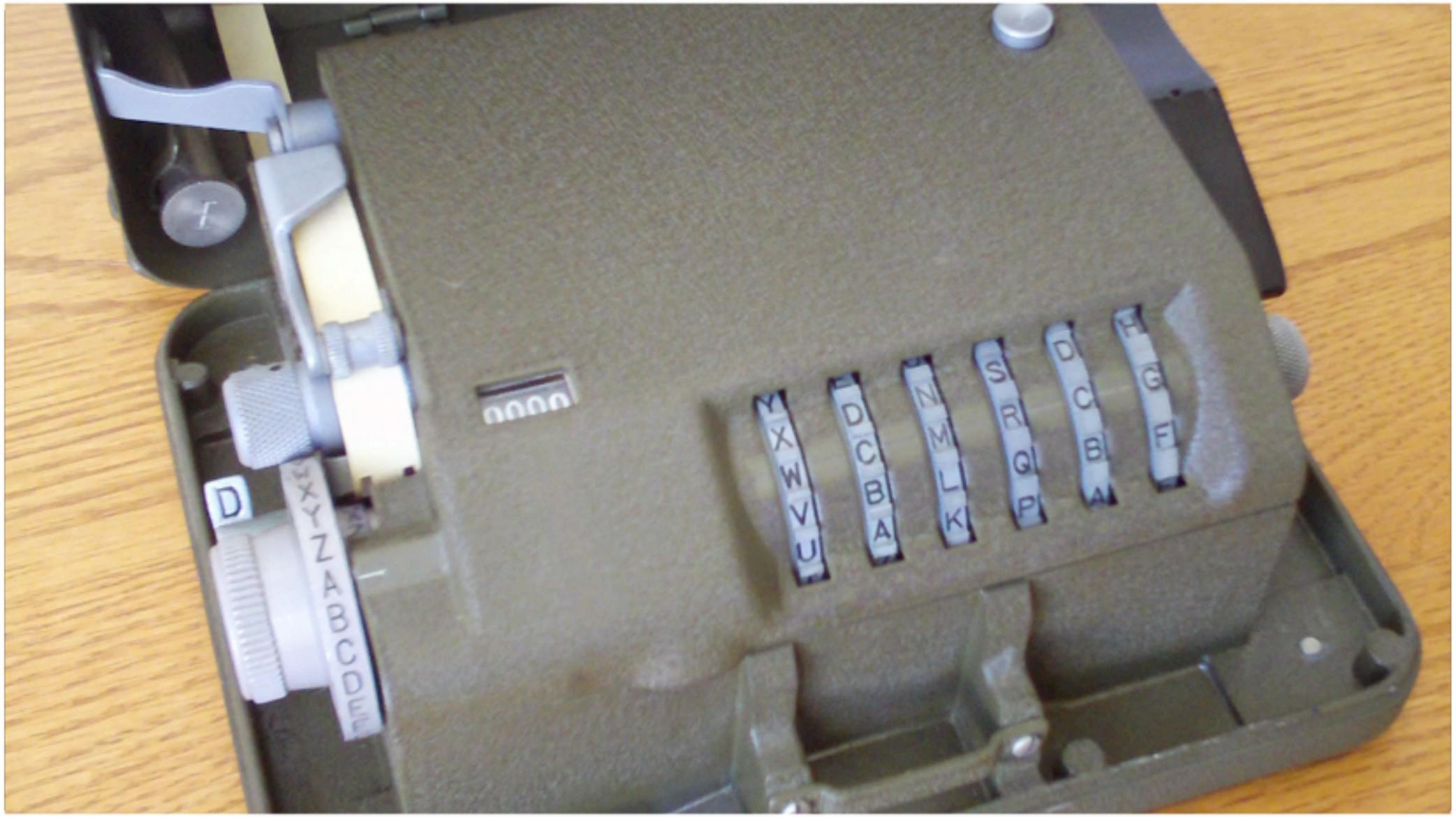
OPERATION

- When ciphering, enter ‘Z’ in place of space
- Ciphertext automatically printed as 5-letter groups
- When deciphering, ignore spaces
- Deciphered ‘Z’ printed as space
- Text may be read from wheel if out of ink/ paper

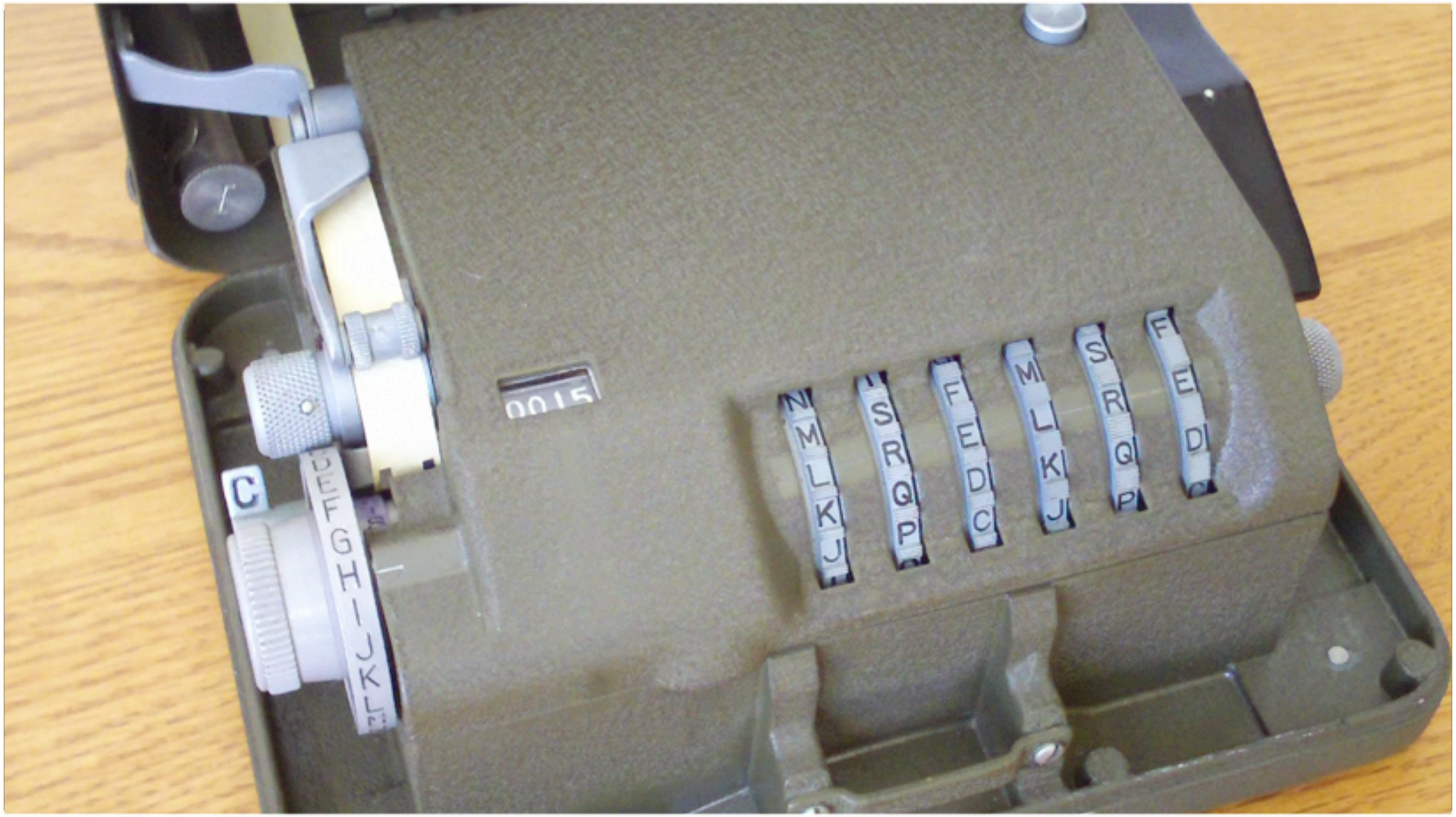
OPERATION

- Drive knob locks after each letter, until setting knob is turned:
- If setting knob is already set to next letter, turn it back and forth to unlock drive knob

CIPHERING



DECIPHERING



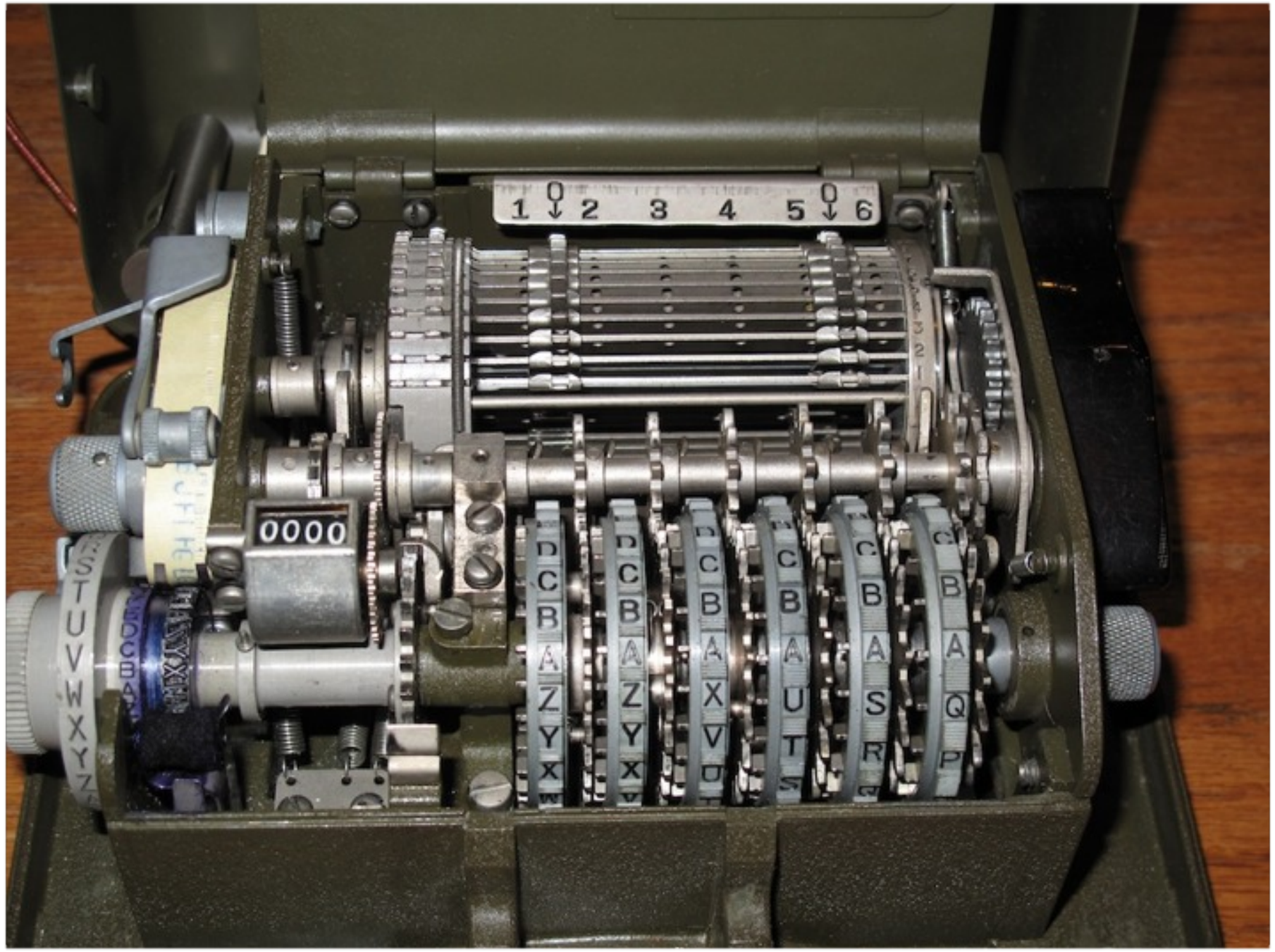
KEYING

- Cipher key consists of two parts:

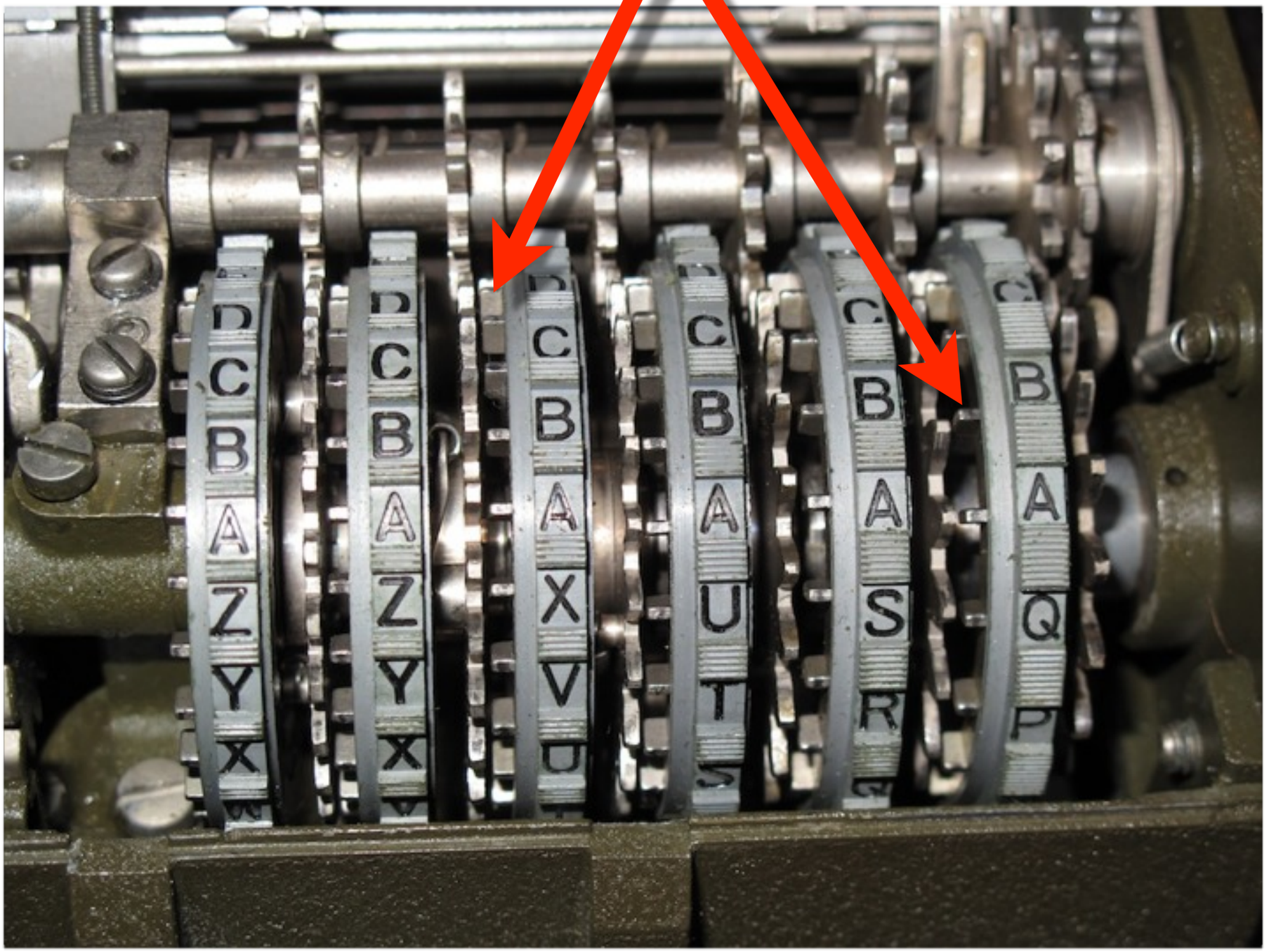
  - Internal pin and lug settings (changed daily on pre-arranged schedule)

  - External key wheel settings (selected randomly for each message)

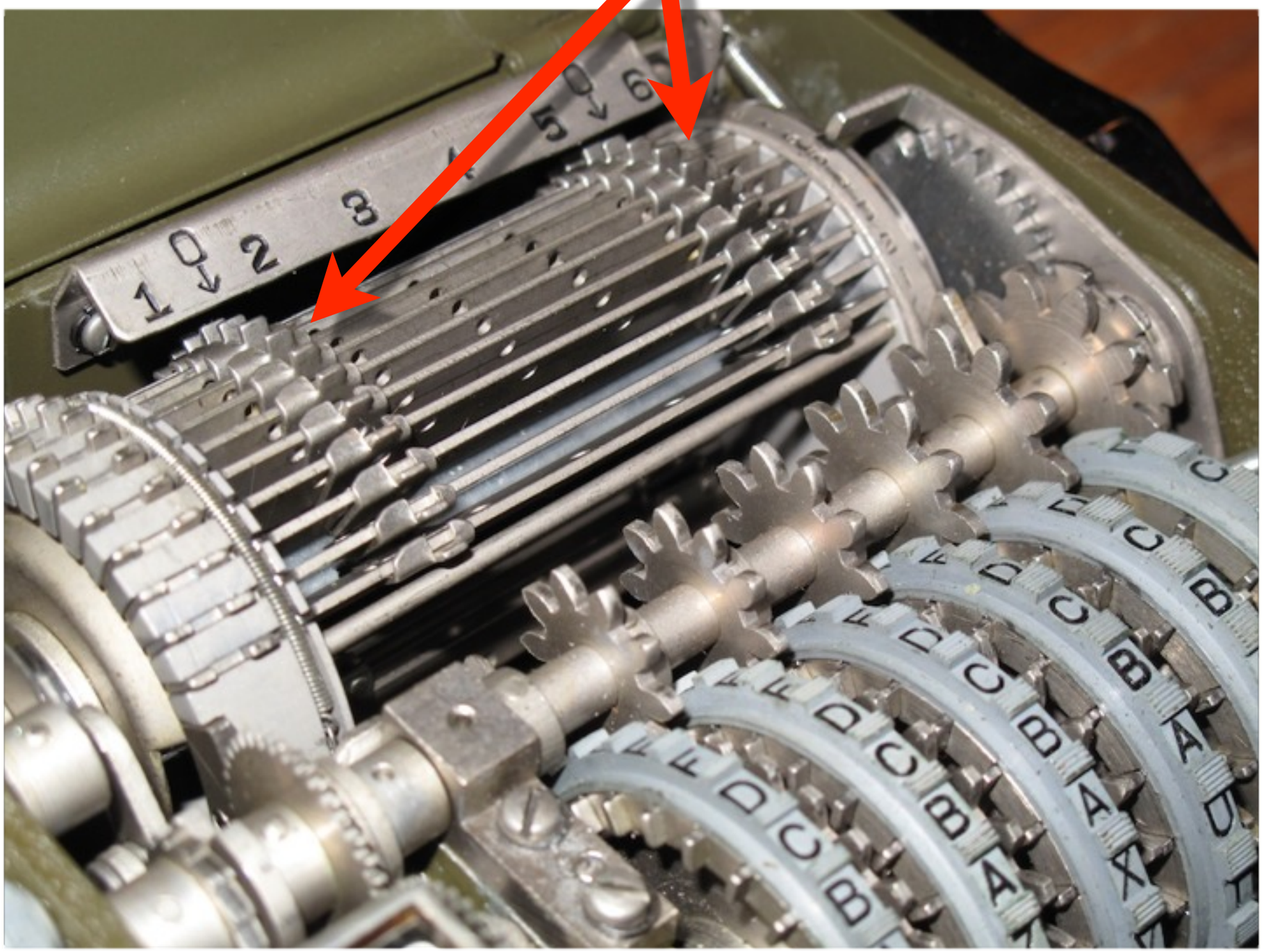
PINS AND LUGS



PINS



LUGS



KEY LIST

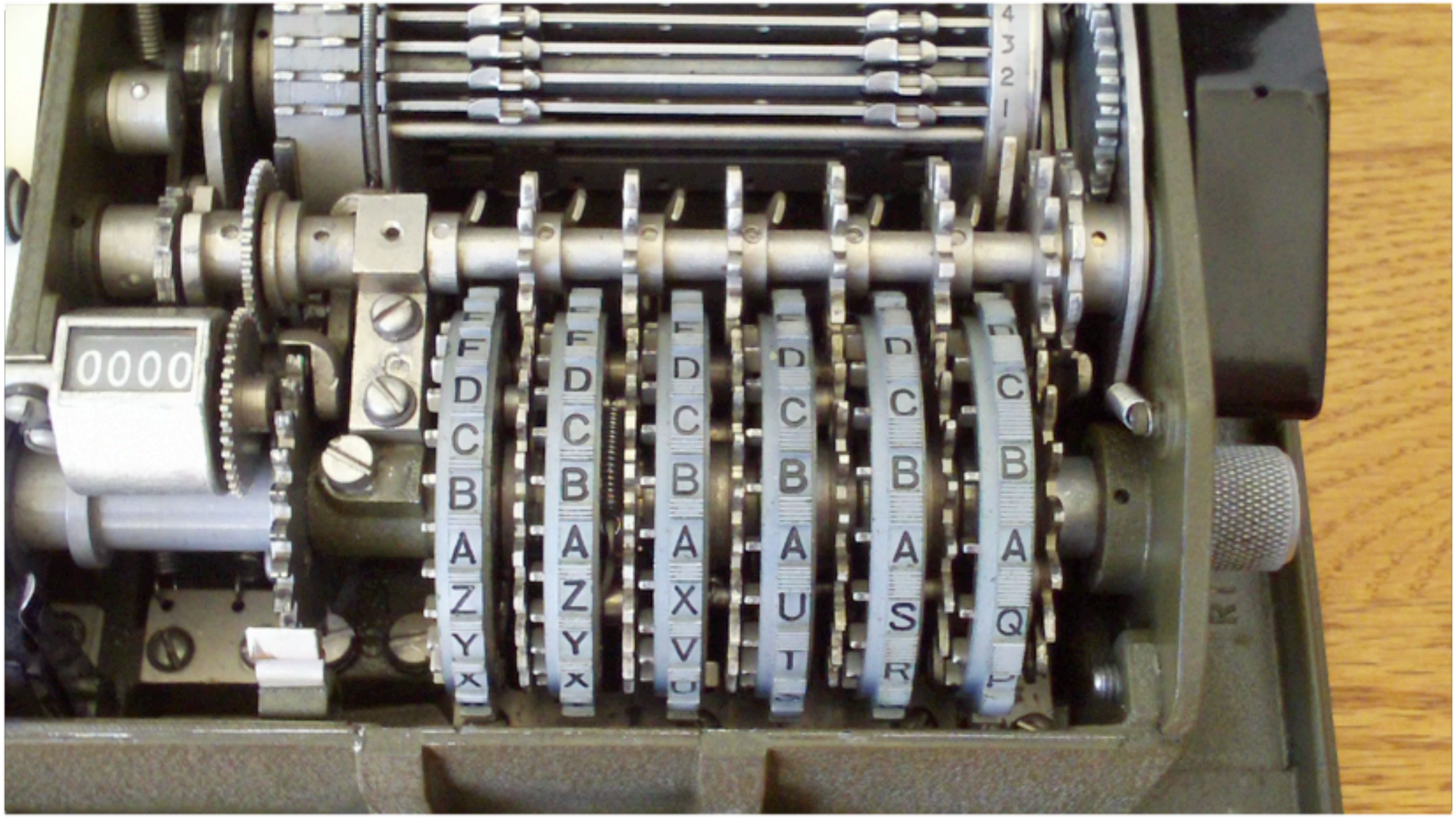
M-209 KEY LIST: BR

NR	LUGS	1	2	3	4	5	6
01	0-1	-	-	A	A	-	-
02	0-1	B	B	-	B	-	-
03	0-1	C	C	C	-	-	-
04	0-1	D	-	D	D	-	-
05	0-1	-	-	-	-	-	E
06	0-2	F	F	-	-	F	F
07	0-2	-	-	-	-	G	G
08	0-2	H	H	-	H	H	-
09	0-2	-	-	-	I	I	-
10	0-2	J	J	J	-	J	-
11	0-2	K	-	K	K	-	-
12	0-2	L	-	-	-	L	L
13	0-3	M	M	M	-	-	M
14	0-3	-	-	N	N	-	N
15	0-4	O	O	-	-	-	O
16	0-4	-	-	P	P	P	P
17	0-4	-	-	-	-	Q	Q
18	0-4	-	R	-	-	-	
19	0-4	S	-	S	S	S	
20	0-4	-	-	-	-		
21	0-4	-	U	-	-		
22	0-4	V	V	V			
23	0-4	-	X	X			
24	0-5	X	-				
25	0-6	Y	-				
26	1-3	Z					
27	3-5						

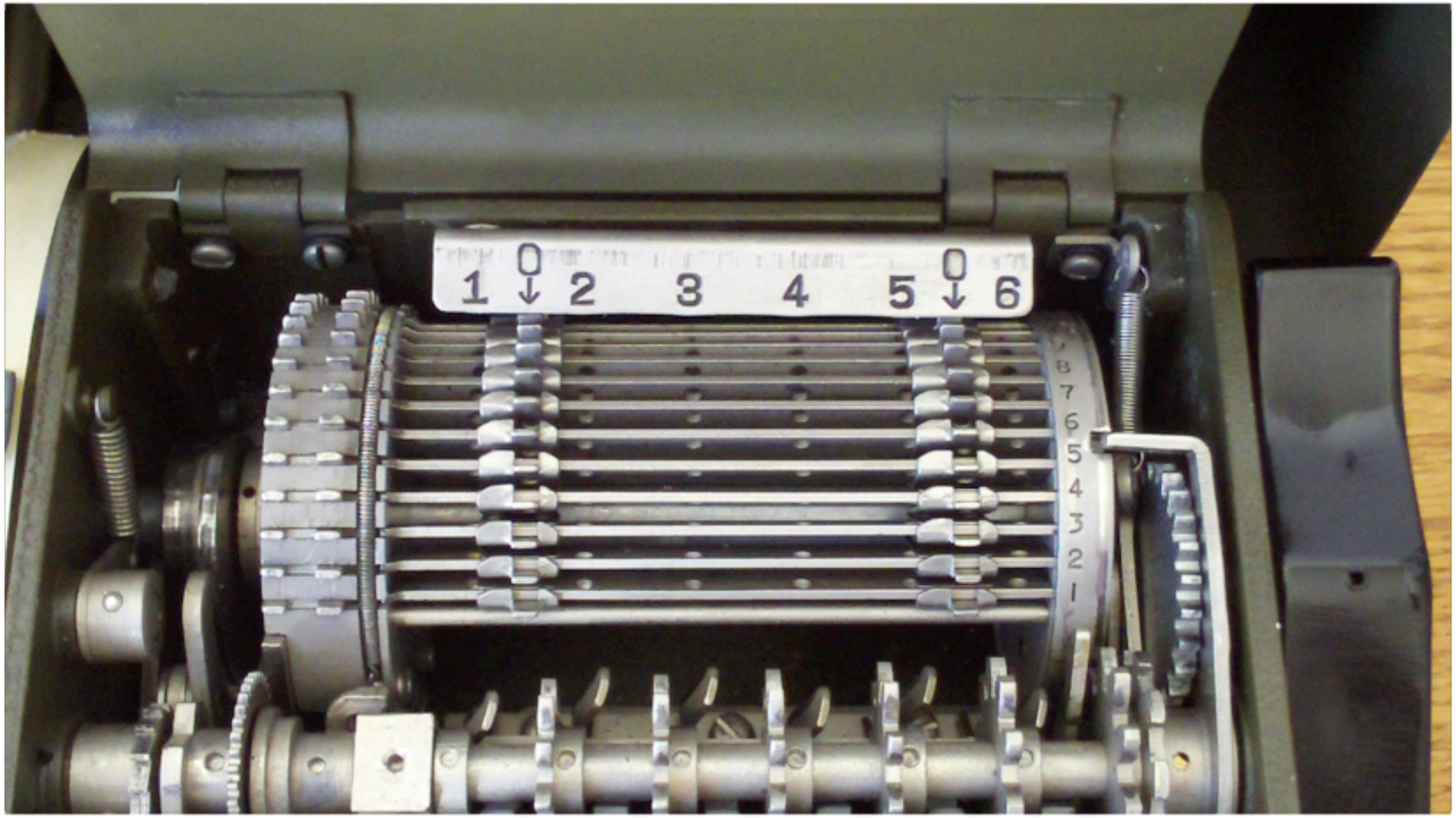
26 LETTER CHECK

LJEWC FWIPR RAZRH BXKNO QGSRK P

SETTING PINS



SETTING LUGS



26 LETTER CHECK

- Easy to make mistakes while setting pins and lugs!
- Key list includes 26 letter test sequence:
  - Set all six key wheels to ‘A’
  - Cipher letter ‘A’ 26 times
  - Compare results to key list

```
------------------------------
26 LETTER CHECK

LJEWC FWIPR RAZRH BXKNO QGSRK P
------------------------------
```

KEY WHEELS

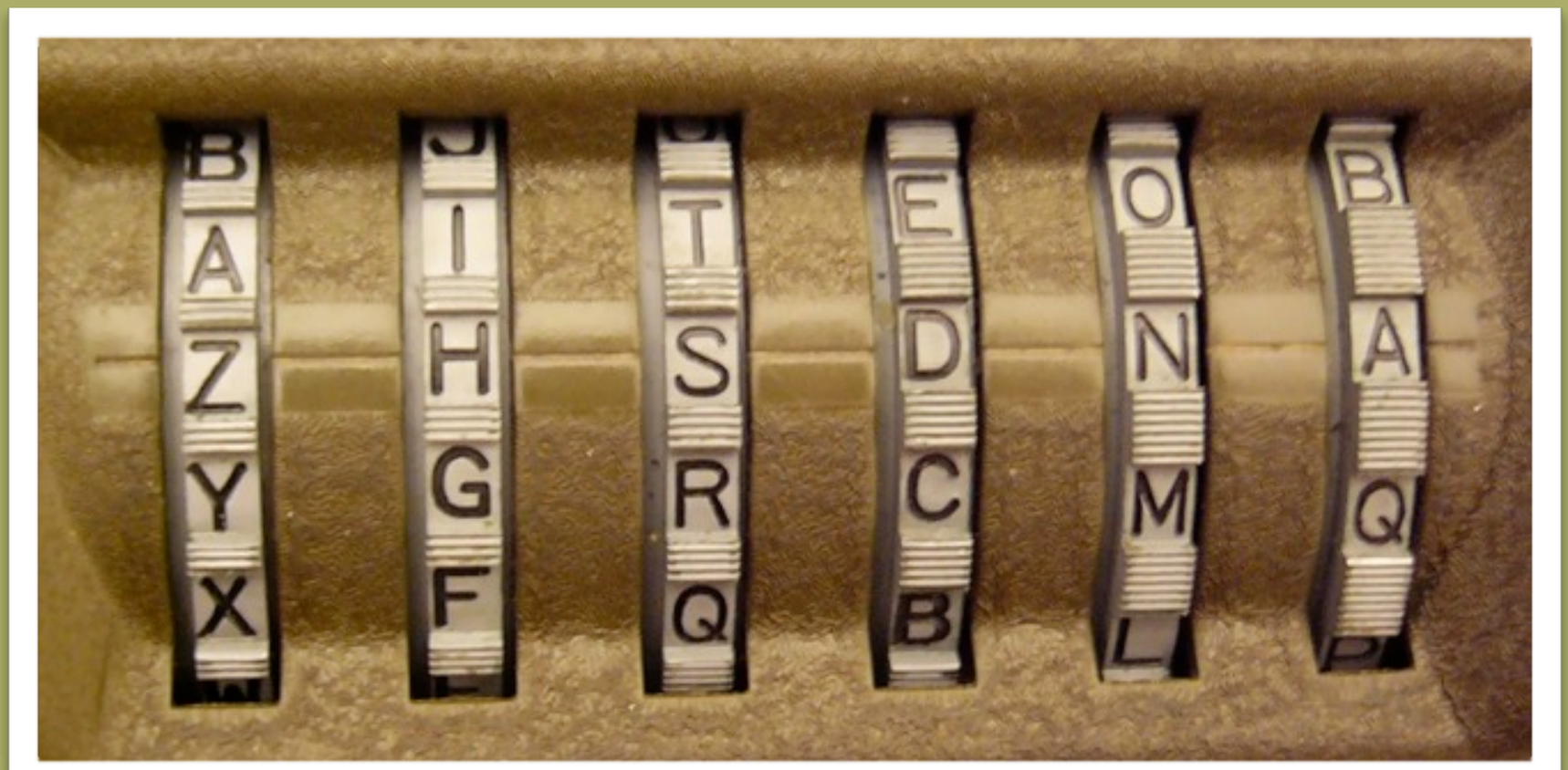
- Six key wheels must be set randomly for each ciphered message
- Never use same settings for more than one message!
- Each wheel has different number of positions: 26, 25, 23, 21, 19, 17
- Each wheel advances one position for each ciphered/deciphered letter

KEY WHEELS

- How to securely send each message's key wheel settings to receiving operator?
- Many methods:
  - Include in message in the clear
  - Use pre-arranged schedule
  - Encipher into the message

KEY WHEELS

- Set wheels to random positions:
  "External Message Indicator"



KEY WHEELS

- Select a random letter, then cipher it 12 times

JYRXW XEDLH VB

KEY WHEELS

- Select first six valid key wheel settings to get "Internal Message Indicator"

JYRXW XEDLH VB

- Use the resulting key wheel settings to cipher the message

MESSAGE INDICATORS

- Ciphertext will include information to let receiving operator recover the key:
  - External Message Indicator (six random letters)
  - Random letter used to generate Internal Message Indicator
  - Key List Indicator (two-letter code which identifies the key list)

MESSAGE INDICATORS

THESE SPACES FOR MESSAGE CENTER ONLY

TIME FILED	MSG CEN NO.	HOW SENT
1300	383	RADIO

NF6X V KE6MYK

PRIORITY (CLASSIFICATION)

MESSAGE (SUBMIT TO MESSAGE CENTER IN DUPLICATE)

No. 42 DATE 1 MAY 2009

To MRCG PRESENTATION

OOZHS DNABR REKGT MIHBZ KRKMR
ANMVL QNMYA DPXRL BFCBQ XQJGL
OVRIX ZVHUJ AMSPN SXDKN GZCCN
FRKGM DWBHO AXNNN EBZZV FHKMT
YTNDQ MZRJF WORGH BROZQ BFNHB
HOSZH AVSKX DNQTQ NSYQS AGQFW
OOZHS DNABR

OFFICIAL DESIGNATION OF SENDER — 1243 TIME SIGNED

AUTHORIZED TO BE SENT IN CLEAR — SIGNATURE OF OFFICER — Mark J Blair SIGNATURE AND GRADE OF WRITER

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	DWBHO	AXNNN	EBZZV	FHKMT
	MZRJF	WORGH	BROZQ	BFNHB
	AVSKX	DNQTQ	NSYQS	AGQFW
	DNABR			

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ANMV	QNMYA	DPXRL	BFCBQ	XQJGL
OVRJK	ZVHUJ	AMSPN	SXDKN	GZCCN
FRKGM	DWBHO	AXNNN	EBZZV	FHKMT
YTNDQ	MZRJF	WORGH	BROZQ	BFNHB
		NQTQ	NSYQS	AGQFW

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FRKGM	DWBHO	AXNNN	EBZZV	FHKMT
YTNDQ	MZRJF	WORGH	BROZQ	BFNHB
LQSZH	AVSKX	DNQTQ	NSYQS	AGQFW

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02 0-1   B  B  -  B  -  -
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Q&A

DEMONSTRATION

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DEMONSTRATION

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No. _____ DATE _____

To _____

WELCOME TO THE TWO THOUSAND
NINE WEST COAST MILITARY RADIO
COLLECTORS GROUP MEETING
PLEASE MEET ME FOR DINNER TONIGHT
AT JOCKOS STEAK HOUSE

OFFICIAL DESIGNATION OF SENDER	TIME SIGNED

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REFERENCES

- *Cryptanalysis of the Hagelin Cryptograph*
  ©1977 Wayne G. Barker
  Aegean Park Press

- *History of the Hagelin Cipher Machines*
  Dirk Rijmenants
  http://users.telenet.be/d.rijmenants/en/hagelin.htm

- http://en.wikipedia.org/wiki/Boris_Hagelin

- TM 11-380, 17 March 1944