

Keyboard with buttons
 associated with ending
 lamps in single panel
 depression of one button
 as with lamp, its lamp
 & another are lighted.

As an authentication
 device - sets up a
 series of auth. symbols.

Combinatoric of crypts
 & authentication
 device

Means for stepping
 rotor - finger piece,
 pawls, levers.

Whe^o Q
Condensed Progress
Reports (Mr. Murray)
Sec 13

2781-A

Security Measures
in Handling Mail

F 3086

Recd Col Patch 99 Jhr
Retd J & L 3 Ok

Case REF ID: A363367

descript - other
features

Insertion of switch
to permit shift from
crypt to authentication

styles + plate switch means

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Rebecca University

~~CONFIDENTIAL~~

which may be used either as a cryptograph

This invention relates to a device or machine for enciphering *or as an authentograph for testing the authenticity of messages* and deciphering communications *which are to be transmitted secretly*

~~in coded or cryptographic form~~

cryptograph or

~~Among~~ ^{*primary*} the objects of this invention ~~is~~ to provide a cipher device which is simple, ^{*in construction and maintenance, but nevertheless*} affords a high degree of security, is light

and readily portable, and can be readily disassembled and rearranged

to vary the ^{*cipher keying elements*} ~~code or~~ ~~arranged or destroyed to prevent its use by~~

~~unauthorized persons.~~

authentograph, that is,

Another object of this invention is to provide an ~~authentication~~ ^{*device for testing the authenticity of signals, thereby providing*} means for ~~indicating that a message~~ ^{*which is to be decoded, has*} ~~originated at an authorized source and is~~ ^{*to be considered*} ~~authentic~~ ^{*authentic*}

Other objects of the invention will become apparent as this description proceeds.

In the drawings,

Fig. 1 is a top or plan view with the covers closed.

Fig. 1a is a side elevation of the front portion of the device with the keyboard cover folded back beneath the same.

Fig. 2 is a top or plan view on an enlarged scale with the keyboard cover and parts of the rotor cover omitted.

Fig. 3 is a side elevation with the covers closed.

Fig. 4 is a cross section on line 4-4 of Fig. 2 with the rotor cover omitted.

Fig. 5 is a perspective view of the rotor latch.

Fig. 6 is a perspective view of the rotor actuating mechanism.

Fig. 7 is a diagram showing schematically the electric circuits and the mechanical operating mechanisms.

Fig. 8 is a view of a portion of the ^{*device*} ~~cryptograph~~ of my ~~invention~~, illustrating a modified keyboard and switching means.

Fig. 9 is a view of a rotor such as is used in the device of this invention.

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That embodiment of the invention selected from among others for illustration in the drawings and description in the specification is as follows. Referring to Fig. 7, the device will be seen, in general, to consist of a source 10 of electricity, ~~shown as a pair of dry cells,~~ connected to a pair of wires 11 and 12 across which are connected a plurality (in this instance, twenty-six) indicators 13A, 13B, 13C, etc. These indicators are illustrated as being electric lamps arranged beneath a keyboard and indicator panel 14 (see Fig. 2) and each arranged to illuminate one perforation closed by a transparent cover 15 bearing one letter 16 of the alphabet thereon. Panel 14 is secured in place over a gasket 14' of soft rubber or the like. Across lines 11 and 12 are also connected manually operable switches 17A, 17B, 17C, etc., each in series with one of the indicators 13A, 13B, etc., ~~and each~~ arranged for operation by ~~a pushbutton or handle~~ 18 projecting through keyboard 14 ^{in proximity to} ~~along side of one of~~ the covers 15.

Connected to each of the indicators 13A, 13B, etc., is a multicontact electric switch, generally indicated as 19. It comprises a number of ^{justaposed and rotatable} relatively turnable, cryptographic ^{switching wheels or} rotors, 19A, 19B, 19C, 19D, ^{in cascade,} 19E, each having a plurality of contacts thereon, ^{and a final wheel} and ^{spring input and output} the output contacts of which are ^{connected in} connections between pairs of the contacts as shown diagrammatically ^{electrical paths} at 20. Each connection ^{leads from one stationary contact} ^{and back, through 20,} leads from one stationary contact through the cryptographic rotors, to another stationary contact. These ^{paths or circuits} connections, 20 are rearranged each time one of the rotors is turned.

^{conductor 11 there is} In ~~lead wire 11 is~~ connected a normally-closed electric switch 21. Between one of the indicators, in this case 13E, and multi-^{there is a} contact switch 19 ~~is~~ connected normally-closed electric switch 22. In parallel with wire 11 is wire 11A containing an authenticating switch 23 having an operating handle 24. Wire 11A also contains a normally-open switch 25.

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Turning now to Figs. 1, ², and 3 for a disclosure of the mechanical features of the invention, the device is shown as enclosed in a casing 26 to which are hinged or otherwise attached a ^{back} rotor cover 27 and a ^{front} keyboard cover 28.

The ^{front cover, protecting the keyboard,} keyboard cover is secured to casing 26 by means of a double hinge 28', 28". This arrangement permits the cover to fit snugly upon gasket 14', thereby to provide a substantially dust-proof and water-proof closure for the keyboard 14. The cover may also lie flat in front of the machine, or may be folded therebeneath ~~(as shown in Figure 11)~~ ^{rotor assembly,}

The back part of the casing, adjacent the ^{Back} rotor, is provided with a lip 26' (see Figure 2). ^{Back} cover ~~member~~ 27 is adapted to fit over this lip, and has a gasket 27' which provides, upon closure of the ^{Back} rotor cover, a dust-proof and moisture-proof seal.

^{In the top of casing 26 there is} ~~Casing 26 has an opening 29 through the top by means of~~ which a counter 30 is visible. As is most readily seen in Fig. 6,

^{rotor assembly 19 is} casing 26 has two projecting walls 26A and 26B. The cryptographic ^a rotors 19 are retained between these walls by mechanism which will now be described. Wall 26A has a hole in it through which may be pushed pin 30A having a knurled head 31 and a latch 32 co-operating with a retaining spring 33. Also pivoted on wall 26A is a spring latch 34 of U-shape, being bent parallel to itself. The free end 34A of latch 34 is perforated to allow pin 30A to pass through it and bears cam surfaces 35 thereon. Stationary cam 36 has a surface complementary to cam surfaces 35 so that when latch 34 is moved from the substantially horizontal position, in which it is shown in Figs. 2, 4, and 6, into the vertical position, in which it is shown in Fig. 5, the free end 34A of latch 34 is moved away from wall 26A and compresses the ~~spring contacts 20A~~ (see Fig. 2) of rotors 19 and locates the rotors themselves in desired ~~positions.~~

~~CONFIDENTIAL~~

entire rotor-reflector assembly 19 as to - sure good contacts there-through

The manually operated means for rotating the cryptographic rotors 19 will next be ^{described} referred to. As seen in Figs. 1, 2, 3, and 6, casing 26 has a recess 37 in its top into which fits a ^{finger} piece 38 having a sliding fit in the recess and mounted on a rod 39. Rod 39 causes U-shaped stirrup 40 to turn ^{on} about its pivots in walls 26A and 26B. ~~Stirrup 40 carries as a part~~ ^{On stirrup 40 is a cam} cam 41 which actuates follower 42 fast on shaft 43 of counter 30. Stirrup 40 also has a ^{member} ~~part~~ 44 to which spring 45 is attached and which carries cam face 46. Detent 47 is pivoted at 48 in walls 26A and 26B and is stressed by spring 49 so that cam 50 engages cam face 46. Spring detents 60 normally hold rotors 19 in their relative positions but allows movement of these rotors under the actuation of pawls 58. This permits detent teeth 51 to be moved in and out of the ratchet depressions in the surface of the rotors 19.

Stirrup 40 carries a pin 52 on which are pivoted a plurality of cam-and-pawl devices 53A, 53B, 53C, and 53D which are urged by springs 54 against cam surfaces 57 or ratchet depressions 56 (see Fig. 7) on rotors 19. ^(see figure 9) Device 53A, for example, ^(figure 6) has a cam surface 55 and a pawl 58 cooperating, respectively, with cam surface 57 and ratchet recesses 56 on the rotor 19A. A tang 59 of device 53A underlies device 53B so that device 53B prevents device 53A from operating unless device 53B is also depressed and ^{operated.} ~~operated.~~

The operation of this device is as follows: ~~To operate the cryptograph,~~ Cover 28 is opened to expose the keyboard. If, as frequently happens, limitations of space require, the cover may be folded back beneath the machine. ^{enciphering or deciphering,} For ~~coding or decoding,~~ ^{operated} handle 24 is ^{located} so that switch 23 is open. That push button

(to decipher the letter E)

To decipher the letter Z the push-button 18 is depressed with the letter Z, is depressed and the circuit is as follows: battery 10, line 11, switch 21, line 11D, switch 17Z, line 20B, through the rotor-reflector assembly, line 20, switch 22, line 11C, lamp 13E, line 12, back to battery 10. Lamp 13E would be illuminated, giving E as the plain-text equivalent of Z. At the same time the lamp 13Z would also be lighted by the closing of switch 17Z and by a circuit which is essentially similar to the one described in connection with the closing of switch 17E.

18 which is associated with the desired letter is depressed

and the switch controlled thereby is operated. For example

if push button 18, associated with depressed switch 17E is closed, connections of switch 17E representing the letter E, is closed, connections

are made from battery 10 through line 11, switch 21, and switch

17E, through lamp 13E, and line 12 back to source 10. This

action also closes connections from switch 17E, through switch

line 20, thence through rotors 19 A, B, C, D and reflector 19 E along conductor

line 12, back to source 10. Lamps 13E and 13Z are the

simultaneously lighted and thus indicate that E is to be

encoded or decoded as the case may be, as Z. Since rotors

19 connect all the lamps 13A, 13B, etc., together in pairs

each letter has another corresponding to it.

For rotating the cryptographic rotors 19 and thus

varying the connections between the various pairs of lamps

finger-piece 38 is depressed, stirrup 40 is rotated about its

pivots and the devices 53A, etc., moved. Whenever one of the

cam faces 55 encounters a depression (shown at 55D in Fig. 13) the corresponding cam 57, the device 58 is moved by spring 54, so

that the pawl 58 enters a notch in the ratchet depression 56 unless

prevented from doing so by the engagement of the tang 59

with the next depression 56. Whenever a pawl 58 enters a ratchet

depression 56, and the movement of the finger-piece 38 is

completed, the corresponding rotor 19 is moved one step. This

rearranges the connections through the rotors and connects

different pairs of lamps 13A, etc., together. Counter 30 is

moved one numeral because follower 42 is depressed by cam 41

and spring returned. Detent 47 prevents backward movement of

rotors 19 because teeth 51 enter notches in rotors 19.

thereupon 17E is closed and connections are made from battery 10 through line 11, switch 21, and switch 17E, through lamp 13E, and line 12 back to source 10. This action also closes connections from switch 17E, through switch line 20, thence through rotors 19 A, B, C, D and reflector 19 E along conductor 20A, thence back through reflector 19 E, rotors 19 D, C, B, A to line 20 B, thence through

Start

Figures 13 and 14

A detailed description of the operation of the device as an autograph

Handwritten notes and initials in the top right corner.

or a signal will now be given. Agreement
 for insuring the authentication of a message switch
 23 is closed by snapping handle 24. Finger-piece 39 is then
 depressed, opening switches 21 and 22 and closing switch 25.
 This movement moves counter 30 one position, and also one or more
 rotors 19 one step. ^{forward} The following ^{than established:} circuit is closed from source 10, line 11,
 line 11A, ^{closed} switch 23, ^{line 11E, closed} switch 25, ^{line 20, thence through the rotor system} rotor connections 20 to whichever
 lamp happens to be paired with lamp 13E. Circuit to lamp 13E is at this time
 so that lamp E is not illuminated but only the lamp corresponding to the letter
 open at switch 22. The designation letter of the lamp which is
 the letter which is thus paired with 13E is transmitted as an authenticator, ^{which will, of course,} an agreement

having been previously reached by the two parties concerned as
 and to the wiring of the several rotors, their arrangement in the
 device, ^{the counter is set to zero, and} and the number of steps having been taken as indicated

by counter 30. ^{be duplicated on a machine similarly set to the same key.}

To remove the rotors 19, cover 27 is opened, latch 34
 moved from the upright position of Fig. 5 to the horizontal
 position of Fig. 6, and pin 30 withdrawn by grasping head 31.
 This allows cam 35 to enter the corresponding groove in
 stationary cam 36. Rotors 19 can then be lifted out and
 destroyed if it is desired to prevent their use by unauthorized
 persons. Or, if the code is to be changed the rotors can be
 reinserted in the casing 26 in a different order or their
 connections 20 changed and the rotors then inserted in casing
 26. ^{is then} Pin 30 placed in position, latch 34 raised, and cover
 27 closed.

Now suppose that the device is being
 used to authenticate a plain language message
 sent from station A to station B. Having
 transmitted the message, station A operates
 its device and finds the authenticating
 letter to be K, for example. This letter is
 transmitted as the authentication; station
 B, operating its device finds that K is
 the correct and hence is warranted in its
 belief that the message comes from an
 authorized source. Upon the next
 authentication, the letter will be
 different, since one or more of the rotors
 will have advanced on the operation
 of the plunger 39.

Push button panel

?

The modification of Fig. 8 includes a viewing panel 60, similar in appearance to the viewing panel and keyboard 14 of Fig. 2. In place of the push buttons 18, however, viewing panel 60 is provided with contacts only, as 61. These contacts, as shown, consisting merely of small circular elements of *all connected by a common return wire 12 to the battery 10.* conducting material. With reference to Fig. 7, contacts 61 may be considered ^{or replacing} ~~to be represented by~~ switches 17A, 17E, etc.

In place of the push buttons 18, a stylus 62 is provided and this may be considered to be connected to conductor 11 of Fig. 7. Encipherment ^{or decipherment} is accomplished by making contact between stylus 62 and a desired contact 61 on panel 60.

The above description is in specific terms, but it is to be understood that the invention is not limited to the precise structures and circuits shown and described. Instead, for the true scope of the invention, reference should be had to the appended claims.

I claim:

1. In a cryptograph having relatively rotatable electric switches, there in, means for ^{angularly displacing} rotating said switches so as to vary the connections therebetween, comprising a plunger or the like arranged for manual operation, means associated with said plunger and cooperating upon depression thereof with one of said electric switches for ^{angularly displacing} rotating the same, means associated with said plunger and cooperating upon depression thereof with another electric switch for ^{angularly displacing} rotating the same after a predetermined ^{angular displacement} rotation of said first mentioned switch, and a brake operable by said plunger through a lost-motion connection for preventing more than a desired ^{angular displacement} rotation of any switch.

2. In a cryptograph, the combination of a source of current, a plurality of ^{w. put - output contacts} ~~inputs~~, a plurality of outputs, a plurality of indicating devices each with a normally open circuit between it and an input ^{contact}, and a normally open circuit between it and every ^{contact} output, and a switch associated with each of said indicating devices and adapted when closed to complete its said first mentioned circuit and one of said second mentioned circuits.

3. The combination of claim 2, further characterized by means for varying the selection of a second mentioned circuit to be completed upon the closing of a switch.

4. The combination of claim 2, further characterized by a plurality of mixing rotors, the normally open circuit between a said indicating device and the said outputs including said rotors.

5. In a ~~cryptographing machine~~, a plurality of cryptographic rotors, stationary input contacts ^{output} ~~and stationary output contacts~~ adapted to be connected variably ^{in pairs} through said rotors, an indicator connected to each of said stationary contacts, a switch associated with each indicator, and a source of current, whereby the closing of one of said switches will close a circuit through a selected input contact and its associated indicator and an output and its indicator.

6. The invention of claim 5 further characterized by means for stepping the rotors.

7. The invention of claim 5 further characterized by a plunger or the like adapted when depressed to ^(advance one or more) rotate ~~a~~ rotors ^{one or more} a predetermined number of steps. **STEP A ROTOR.**

8. The combination with a ^{device} ~~cryptographing machine~~ having a plurality of electrical inputs for the characters to be enciphered, a plurality of electrical outputs for the enciphered equivalents of said characters, a viewing panel or the like including a lamp for each character, a switch associated with each lamp and with a source of current, and a plurality of circuits each including said source, one of said switches, a lamp associated therewith, an input corresponding to the character represented by said lamp, and a lamp corresponding to the output associated with the last mentioned input, whereby the closing of one of said switches will light a lamp representing a character to be enciphered and a lamp representing the enciphered equivalent of said character.

9. In a ~~cryptographing machine~~, the combination of a plurality of electrical inputs for the characters to be enciphered, a plurality of electrical outputs for the enciphered equivalents of said characters, a source of current, a viewing panel or the like including a lamp for each character, an electrical contact associated with each lamp, a contacting member, and a plurality of normally open circuits each including said source, said contacting member, one of said electrical contacts, the lamp and input corresponding to the character associated with said contact, and a lamp corresponding to the output associated with the last mentioned input, whereby a contact between said contacting member and one of said contacts will light a lamp representing the enciphered equivalent of said character.

10. In ^{an autheutograph,} ~~a cryptographing machine~~, a source of current, a plurality of cryptographic rotors, stationary ^(input) contacts ^{in pairs} and stationary output contacts adapted to be connected ^{variably} through said rotors, an indicator connected to each of said stationary contacts, a plunger or the like adapted when ^{(angularly displaced one or more of said rotors,} depressed to ~~rotate a rotor a predetermined number of steps,~~ a switch associated with each indicator, an additional normally open switch controlling a circuit between ^{one stationary} a predetermined input contact and ^{another stationary} an output contact and its indicator, and a further normally open switch adapted to be closed by said plunger thereby to energize the indicator associated with said output only if said additional normally open switch is closed.

11. In a combination with a cryptographic ^{device} machine adapted to receive input signals representing characters to be enciphered and to mix the signals and to indicate to an operator both input and enciphered characters, an authenticator adapted when actuated to indicate the output character associated with a predetermined input character.

12. In combination with a cryptographic ^{device} machine adapted to receive input signals representing characters to be enciphered and including a ^{set of cryptographic rotors in cascade} rotor for mixing the signals, means for indicating to an operator both input and enciphered characters, means for stepping the rotors, and means for recording the steps of said rotors, and an authenticator adapted when actuated to indicate only the enciphered character instantaneously associated with a predetermined input character.

13. The method of providing an authentication for a secret message comprising characters enciphered by a ^{set of cryptographic} stepping rotor, which includes recording the steps of the rotors and utilizing the enciphered equivalent of a predetermined character after a predetermined number of steps of said rotors.

14. The method of authenticating a message ^{by} characters enciphered by an electrical system of stepping cryptographic rotors having an input contact and an output contact for each character which comprises providing a circuit including a predetermined input contact and an output contact dependent upon the instantaneous positions of said rotors, and utilizing the enciphered equivalent of the character associated with said predetermined input contact for known conditions of said rotors.

851531

RP

Friedman

REF ID: A363367

January 1944

Objects.

Title: Cipher Device.

This invention relates to a device or machine for enciphering and deciphering communications which are to be transmitted secretly in coded or cryptographic form.

Among the objects of this invention are to provide a cipher device which is simple yet affords a high degree of security, is light and readily portable, and can be readily disassembled and rearranged to vary the code or deranged or destroyed to prevent its use by unauthorized persons.

Another object of this invention is to provide an authenticator or means for indicating that a message, which is to be decoded, ~~is~~ ^{has} originated from an authorized source.

Other objects of the invention will become apparent as this description proceeds.

In the drawings,
 Fig. 1 is a top or plan view with the covers closed.
 Fig. 2 is a top or plan view on an enlarged scale with the keyboard cover and part of the rotor cover omitted.
 Fig. 3 is a side elevation with the covers closed.
 Fig. 4 is a cross section on line 4-4 of Fig. 2 with the rotor cover omitted.
 Fig. 5 is a perspective view of the rotor latch.
 Fig. 6 is a perspective view of the rotor actuating mechanism.

Fig. 7 is a diagram showing the electric circuits and the mechanical operating mechanisms.

That embodiment of the invention selected from among others for illustration in the drawings and description in the specification is as follows. Referring to Fig. 7, the device will

be seen, in general, to consist of a source 10 of electricity, shown as a pair of dry cells, connected to a pair of wires 11 and 12 across which are connected a plurality (in this instance, twenty-six) indicators 13 A, 13 B, 13 C, etc. These indicators are illustrated as being electric lamps arranged beneath a keyboard 14 (See Fig. 2) and each arranged to illuminate one perforation closed by a transverse

#3.

cover 15 bearing one letter¹⁶ of the alphabet thereon. across lines 11 and 12 are also connected manually operable switches 17A, 17B, 17C etc. in series with one of the indicators 13A, 13B, etc. and each is arranged for operation by a push button or handle 18 projecting through key board 14 along side of one of the covers 15.

Connected to each of the indicators 13A, 13B, etc. is a multi-contact electric switch, generally indicated as 19. It comprises a number of relatively turnable ^{cryptographic} rotors, 19A, ... 19E, each having a plurality of contacts thereon and connections between ^{pairs of} the contacts as shown diagrammatically at 20. Each connection 20 leads from one stationary contact through the cryptographic rotors to another stationary contact. These connections 20 are rearranged each time one of the rotors is turned.

A lead wire 11 is connected a normally-closed electric switch 21. Between one of the covers 1

indicators, in this case 13E, and multi-contact switch 19 is connected normally-closed electric switch 22. In parallel with wire 11 is wire 11A containing an authenticating switch 23 having an operating handle 24. Wire 11A also contains a normally open switch 25.

Turning now to Fig. 1, 2 and 3 for a disclosure of the mechanical features of the invention, the device is shown as enclosed in a casing 26 to which are hinged or otherwise attached a rotor cover 27 and a keyboard cover 28. Casing 26 has an opening 29 through the top by means of which a counter 30 is visible. As is most readily seen in Fig. 6, casing 26 has two projecting walls 26A and 26B. The cryptographic rotors 19 are retained between these walls by mechanism which will now be described. Wall 26A has a hole in it through

which may be pushed pin 30 having a knurled head 31 and a latch 32 co-operating with a retaining spring 33. Also pivoted on wall 26A is a spring latch 34 of U-shape being bent back parallel to itself. The free end of latch 34 is perforated to allow pin 30 to pass through it and bears cam surfaces 35 thereon. Stationary cam 36 has a surface complementary to cam surfaces 35 so that when latch 34 is moved from the substantially horizontal position, in which it is shown in Figs. 2, 4 and 6, into the vertical position, in which it is shown in Fig. 5, the free end of latch 34 is moved away from wall 26A and compresses the spring 20A (see Fig. 2) and locates the rotors themselves in desired position.

The manually operated means for rotating the cryptographic rotors 19 will next be referred to. As seen in Figs. 1, 2, 3 and 6, casing 26 has a recess 37 in its top into which fits a finger piece 38 having a sliding fit in the recess and mounted on a rod 39. Rod 39 causes U-shaped

8 pins detent 69 assembly hold rotors 19 in their relative positions in flow movements of these rotors under the actuation of pawls 58.

stirrup 40 to turn about its pivots in walls 26A and 26B. Stirrup 40 carries as a part cam 41 which actuates follower 42 part of shaft 43 of counter 30. Stirrup 40 also has a part 44 to which spring 45 is attached and which carries cam face 46. Detent 47 is pivoted at 48 in walls 26A and 26B and is depressed by spring 49 so that cam 50 engages cam face 46. This permits detent teeth 51 to be moved in and out of the ratchet depressions in the surface of the rotors 19. Stirrup 40 carries a pin 52 on which are pivoted a

plurality of cam-and-pawl devices 53A 53B 53C, and 53D which are urged by springs 54 against cam surfaces 57 or ratchet depressions 56 (see pg 2) of rotors 19. Device 53A for example, has a cam surface 55 and a pawl 58 cooperating respectively, with cam surface 57 and ratchet-recesses 56 on the rotor 19A, a tang 59 of device 53A overlaps device 53B so that device 53B prevents device 53A from operating unless device 53B is also depressed and operating.

The operation of this device is as follows. For coding or decoding, handle 24 is located so that switch 23 is open. That push button 18 which is associated with the desired letter is depressed and the switch controlled thereby is operated. For example if switch 17E representing the letter E is closed, connections are made from battery 10 through line 11, switch 21 and switch 17E through lamp 13E, and line 12 back to source 10.

This action also does
 connections are also closed from switch 17 E
 through switch 22 and connections 20 of rotors
 19 to lamp 13 Z and thence through line 12
 back to source 10. Lamps 13 E and 13 Z are
 therefore simultaneously lighted and thus
 indicate that E is to be encoded or decoded
 as the case may be, as Z, and vice versa.
 Since rotor 19 connect all the lamps 13 A,
 13 B etc. together in pairs, each letter has another
 corresponding to it.

For rotating the cryptographic rotors 19
 and thus varying the connections between the
 various pairs of lamps, finger piece 38 is
 depressed, stirrup 40 is rotated about its pivots
 and the device 53 A, etc. moved. Whenever one
 of the cam faces 55 encounters a depression
 (shown at 55 D in Fig. 4) in the corresponding
 cam 57, the device 53 is moved by spring 54
 so that the pawl 58 enters the ratchet
 depression 56 unless prevented from doing so
 by the engagement of the tang 59 with the
 ratchet device 53. Whenever a pawl 58 enters a
 ratchet depression 56, and the movement of the
 finger-piece 38 is completed, the corresponding
 rotor 19 is moved one step. This rearranges
 the connections 20 through the rotors and
 connects different pairs of lamps 13 A, etc. together.
 Counter 30 is moved one numeral because
 follower 42 is depressed by cam 41 and spring
 returned. Patent 47 prevents backward
 movement of rotors 19 because teeth 51 enter
 ratchet depressions in rotors 19.

For insuring the authenticity of a message,
 switch 23 is closed by snapping handle 24.
 (over)

It may piece 38 is then depressed, opening switches 21 and 22 and closing switch 25. This movement moves counter 30 one position and also one or more rotors 19 one step. Circuit is closed from source 10, line 11, line 11A, switch 23, switch 25, rotor connections 20 to whichever lamp happens to be paired with lamp 13E. Circuit to lamp 13E is open at switch 22. This action insured that the rotors 19 are connected up in the same way and, by agreement upon the setting of counter 30, that the message is authentic or, in other words, originates at an authorized source.

To readily remove the rotors 19, cover 27 is opened, pin 30 withdrawn by grasping head 31 and latch 34 moved from the upright position of Fig. 5 to the horizontal position of Fig. 6. This allows cam 35 to enter the corresponding groove in stationary cam 36. Rotors 19 can then be lifted out and destroyed if it is desired to prevent their use by unauthorized persons. Or if the code is to be changed the rotors can be reinserted in the casing 26 in a different order or their connections 20 changed and the rotors then reinserted in casing 26, pin 30 placed in position, latch 34 raised, and cover 27 closed.

Fig. 3

Authenticator.

REF ID: A36336

January 1944.

Claims.

A.
↓

1. In a cryptographing machine,
means for insuring the authenticity of the
message transmitted, said means comprising,
a transposing device for transposing
characters from text to cipher or the reverse,
a handle connected as to be operable to move
said device into each of its ciphering
combinations,
and indicators, one of which is actuated upon
each actuation of said handle, which, upon
actuation, indicate a selected character.

2.- A plus

- B a source of electricity
- C ~~connected to one side of said source and each~~
 electric lamps each adapted, when lighted,
 to designate one character,
- E a multi-contact electric switch connected
 into circuit between said ~~source and said~~
 lamps and operable to connect said lamps to
~~said source~~ in various arrangements,
 and
- D a second switch mechanically arranged as to
 to be closed when said multi-contact
 switch is operated from one position to another and
 connected into circuit ~~between~~ said multi-contact switch,
 whereby current is closed through one lamp which
 gives an authenticating signal.
3. Claim 2 omitting "and" plus - and
 H a third switch connected in series with said
 second switch and said source as to control
 the connections therebetween.
- and the other side of said source ←

7 January 1949.

4. A, B, C plus -
E a multi-'contact' electric switch connected into circuit between said source and said lamps and operable to connect said lamps in pairs, ~~across said battery,~~ and

F a normally-closed electric switch connected ^{the other side of} between said source and each of said lamps so as to control the connection therebetween and mechanically arranged so as to be opened when said multi-contact switch is operated from one position to another.

5. Claim 4 omitting "and" plus -, D.

~~6. A, B, C plus - manually operable switches, each connected between the other side of said source and one of said lamps~~ (normally open)

6. A, B, C - plus
 G manually operable, normally open electric switches, each connected between the other side of said source and one of said lamps, whereby, when one of said manually operable switches is closed, circuit is established through the lamp to which it is adjacent and through said multi-contact ^{switch} and another of said lamps to indicate a cipher character, E, and, D.

7. Claim 6, omitting "and" plus, and a normally closed electric switch connected between the other side of said source and each of said manually operable switches and mechanically arranged so as to be closed when said multi-contact switch is moved from one position to another.

8 January 1949.

8. A coding device comprising,
 a panel having a plurality of ^{electric} switch-operating
 handles projecting therethrough, a plurality of electric
 switches each operated by one of said handles,
 a plurality of electric lights each associated
 with one of said handles and each carrying
 character-indicating indicia thereon,
 a plurality of cryptographing rotors having
 stationary contacts each connected to one of said
 lights and bridging contacts connecting said
 lights in pairs,
 an operator having a lost-motion connection
 with said rotors to move said rotors step-by-
 step,

a normally-closed electric switch in series with
 each of said handle-operated switches and a source
 of current,

and
 a normally-open electric switch in series with one
 of the stationary contacts of said rotors and said source
 of current. (over)

said operator acting to open said normally-closed switch and to close said normally-open switch upon each step in the movement of said rotors.

9. Claim 8 omitting "and" plus - and, a counter connected under the control of said operator so as to indicate the number of actuations of said rotors.

17 January 1943.

Friedman: Claims.

10. In a cryptographing machine having ^{relatively} rotary electric switches therein means for manually rotating said ^{individually} switches so as to vary the connections therebetween, said means comprising, a finger piece arranged for manual operation, a pivotally mounted strip located under the control of said finger piece, and a plurality of cam- and-pawl devices pivotally mounted on said strip and each stressed against a cam surface on one of said switches and arranged to enter one ratchet opening on said switch when not restrained by said cam surface and movable together with said strip to turn said switch.

11. In a cryptographing machine having a plurality of cam- and-pawl devices, said devices each having a cam surface and a ratchet opening, and each device being stressed against a cam surface on one of said switches and arranged to enter one ratchet opening on said switch when not restrained by said cam surface and movable together with said strip to turn said switch, and tangs on all but one of said devices, said tangs each overlying the preceding device whereby one of said devices is operative at each actuation of said finger piece, and each successive device can become operative only when it is permitted to do so by the cam surface which controls it and by all the preceding devices.

12. In a cryptographing machine containing a number of rotors a latch for restraining said rotors in position comprising, a U-shaped member of spring material having

12 (cont.) ^{one end} pivotally mounted at the other end
 free for longitudinal movement into and out
 of contact with the end one of said rollers
 a cam surface on said free end, and a stationary
 cam co-operating with said cam surface
 to move said free end when said latch is
 turned about its pivot.

This invention relates to a device or machine for enciphering and deciphering communications which are to be transmitted secretly in coded or cryptographic form.

Among the objects of this invention are to provide a cipher device which is simple yet affords a high degree of security, is light and readily portable, and can be readily disassembled and rearranged to vary the code or deranged or destroyed to prevent its use by unauthorized persons.

Another object of this invention is to provide an authenticator or means for indicating that a message, which is to be decoded, has originated at an authorized source.

Other objects of the invention will become apparent as this description proceeds.

In the drawings,

Fig. 1 is a top or plan view with the covers closed.

Fig. 2 is a top or plan view on an enlarged scale with the keyboard cover and parts of the rotor cover omitted.

Fig. 3 is a side elevation with the covers closed.

Fig. 4 is a cross section on line 4-4 of Fig. 2 with the rotor cover omitted.

Fig. 5 is a perspective view of the rotor latch.

Fig. 6 is a perspective view of the rotor actuating mechanism.

Fig. 7 is a diagram showing schematically the electric circuits and the mechanical operating mechanisms.

That embodiment of the invention selected from among others for illustration in the drawings and description in the specification is as follows. Referring to Fig. 7, the device will be seen, in general, to consist of a source 10 of electricity, shown as a pair of dry cells, connected to a pair of wires 11 and 12 across which are connected a plurality (in this instance, twenty-six) indicators 13A, 13B, 13C, etc. These indicators are illustrated as being electric lamps arranged beneath a keyboard 14 (see Fig. 2) and each arranged to illuminate one perforation closed by a transparent cover 15 bearing one letter 16 of the alphabet thereon. Across lines 11 and 12 are also connected manually operable switches 17A, 17B, 17C, etc., each in series with one of the indicators 13A, 13B, etc., and each arranged for operation by a pushbutton or handle 18 projecting through keyboard 14 along side of one of the covers 15.

Connected to each of the indicators 13A, 13B, etc., is a multi-contact electric switch, generally indicated as 19. It comprises a number of relatively turnable cryptographic rotors, 19A ——— 19E, each having a plurality of contacts thereon and connections between pairs of the contacts as shown diagrammatically at 20. Each connection 20 leads from one stationary contact through the cryptographic rotors to another stationary contact. These connections 20 are rearranged each time one of the rotors is turned.

In lead wire 11 is connected a normally-closed electric switch 21. Between one of the indicators, in this case 13E, and multi-contact switch 19 is connected normally-closed electric switch 22. In parallel with wire 11 is wire 11A containing an authenticating switch 23 having an operating handle 24. Wire 11A also contains a normally-open switch 25.

Turning now to Figs. 1, 2 and 3 for a disclosure of the mechanical features of the invention, the device is shown as enclosed in a casing 26 to which are hinged or otherwise attached a rotor cover 27 and a keyboard cover 28. Casing 26 has an opening 29 through the top by means of which a counter

30 is visible. As is most readily seen in Fig. 6, casing 26 has two projecting walls 26A and 26B. The cryptographic rotors 19 are retained between these walls by mechanism which will now be described. Wall 26A has a hole in it through which may be pushed pin 30A having a knurled head 31 and a latch 32 co-operating with a retaining spring 33. Also pivoted on wall 26A is a spring latch 34 of U-shape being bent parallel to itself. The free end 34A of latch 34 is perforated to allow pin 30A to pass through it and bears cam surfaces 35 thereon. Stationary cam 36 has a surface complementary to cam surfaces 35 so that when latch 34 is moved from the substantially horizontal position, in which it is shown in Figs. 2, 4, and 6, into the vertical position, in which it is shown in Fig. 5, the free end 34A of latch 34 is moved away from wall 26A and compresses the spring contacts 20A (see Fig. 2) of rotors 19 and locates the rotors themselves in desired positions. The manually operated means for rotating the cryptographic rotors 19 will next be referred to. As seen in Fig. 1, 2, 3, and 6, casing 26 has a recess 37 in its top into which fits a finger piece 38 having a sliding fit in the recesses and mounted on a rod 39. Rod 39 causes U-shaped stirrup 40 to turn about its pivots in walls 26A and 26B. Stirrup 40 carries as a part cam 41 which actuates follower 42 fast on shaft 43 of counter 30. Stirrup 40 also has a part 44 to which spring 45 is attached and which carries cam face 46. Detent 47 is pivoted at 48 in walls 26A and 26B and is stressed by spring 49 so that cam 50 engages cam face 46. Spring detents 60 normally hold rotors 19 in their relative positions but allows movement of these rotors under the actuation of pawls 58. This permits detent teeth 51 to be moved in and out of the ratchet depressions in the surface of the rotors 19. Stirrup 40 carries a pin 52 on which are pivoted a plurality of cam-and-pawl devices 53A, 53B, 53C, and 53D which are urged by springs 54 against cam surfaces 57 or ratchet depressions 56 (see Fig. 7) on rotors 19. Device 53A for example, has a cam surface 55 and a pawl 58 cooperating, respectively,

with cam surface 57 and ratchet recesses 56 on the rotor 19A. A tang 59 of device 53A overlies device 53B so that device 53B prevents device 53A from operating unless device 53B is also depressed and operating.

The operation of this device is as follows: For coding or decoding handle 24 is located so that switch 23 is open. That push button 18 which is associated with the desired letter is depressed and the switch controlled thereby is operated. For example if switch 17E representing the letter E is closed, connections are made from battery 10 through line 11, switch 21 and switch 17E through lamp 13E, and line 12 back to source 10. This action also closes connections from switch 17E through switch 22 and connections 20 or rotors 19 to lamp 13Z and thence through line 12 back to source 10. Lamps 13E and 13Z are therefore simultaneously lighted and thus indicate that E is to be encoded or decoded as the case may be, as Z and vice versa. Since rotors 19 connect all the lamps 13A, 13B, etc., together in pairs each letter has another corresponding to it.

For rotating the cryptographic rotors 19 and thus varying the connections between the various pairs of lamps, finger-piece 38 is depressed, stirrup 40 is rotated, about its pivots and the devices 53A etc., moved. Whenever one of the cam faces 55 encounters a depression (shown at 55B in Fig. 4) in the corresponding cam 57 the device 53 is moved by spring 54 so that the pawl 58 enters the ratchet depression 56 unless prevented from doing so by the engagement of the tang 59 with the next device 53. Whenever a pawl 58 enters a ratchet depression 56, and the movement of the finger-piece 38 is completed, the corresponding rotor 19 is moved one step. This rearranges the connections 20 through the rotors and connects different pairs of lamps 13A, etc., together. Counter 30 is moved one numeral because follower 42 is depressed by cam 41 and spring returned. Detent 47 prevents backward movement of rotors 19 because teeth 51 enter depressions in rotors 19.

For insuring the authenticating of a message, switch 23 is closed by snapping handle 24. Finger-piece 38 is then depressed, opening switches 21

and 22 and closing switch 25. This movement moves counter 30 one position and also one or more rotors 19 one step. Circuit is closed from sources 10, line 11, line 11A, switch 23, switch 25, rotor connections 20 to whichever lamp happens to be paired with lamp 13E. Circuit to lamp 13E is open at switch 22. The designation letter of the lamp which is paired with 13E is transmitted as an authenticator, an agreement having been previously reached by the two parties concerned as to the wiring of the several rotors, their arrangement in the device, and the number of steps having been taken as indicated by counter 30.

To readily remove the rotors 19, cover 27 is opened, latch 34 moved from the upright position of Fig. 5 to the horizontal position of Fig. 6, and pin 30 withdrawn by grasping head 31. This allows cam 35 to enter the corresponding groove in stationary cam 36. Rotors 19 can then be lifted out and destroyed if it is desired to prevent their use by unauthorized persons. Or if the code is to be changed the rotors can be reinserted in the casing 26 in a different order or their connections 20 changed and the rotors then inserted in casing 26, pin 30 placed in position, latch 34 raised, and cover 27 closed.

1. In a cryptographing machine, means for insuring the authenticity of the message transmitted, said means comprising, a transposing device for transposing characters from text to cipher or the reverse, a finger piece connected so as to be operable to move said device into each of its ciphering combinations, and indicators, one of which is actuated upon each actuation of said finger piece, and which upon actuation, indicates a selected character.

2. In a cryptographing machine, means for insuring the authenticity of the message transmitted, said means comprising, a source of electricity, electric lamps each connected to one side of said source and each adapted, when lighted, to designate one character, a multi-contact electric switch connected into circuit between said lamps and operable to connect said lamps in various arrangements, and a second switch mechanically arranged so as to be closed when said multi-contact switch is operated from one position to another and to be connected into circuit between said multi-contact switch and the other side of said source whereby circuit is closed through one lamp which gives an authenticating signal.

3. In a cryptographing machine, means for insuring the authenticity of the message transmitted, said means comprising, a source of electricity, electric lamps each connected to one side of said source and each adapted, when lighted, to designate one character, a multi-contact electric switch connected into circuit between said lamps and operable to connect said lamps in various arrangements, a second switch mechanically arranged so as to be closed when said multi-contact switch is operated from one position to another and connected into circuit between said multi-contact switch and the other side of said source, whereby circuit is closed through one lamp, which gives an authenticating signal, and a third switch connected in series with said second switch and said source so as to control the connections therebetween.

4. In a cryptographing machine, means for insuring the authenticity of the message transmitted, said means comprising, a source of electricity, electric lamps each connected to one side of said source and each adapted, when lighted, to designate one character, a multi-contact electric switch connected into circuit between said lamps and operable to connect said lamps in various arrangements, and a normally-closed electric switch connected between the other side of said source and each of said lamps so as to control the connection therebetween and mechanically arranged so as to be opened when said multi-contact switch is operated from one position to another.

5. In a cryptographing machine, means for insuring the authenticity of the message transmitted, said means comprising, a source of electricity, electric lamps each connected to one side of said source and each adapted, when lighted, to designate one character, a multi-contact electric switch connected into circuit between said lamps and operable to connect said lamps in various arrangements, a second switch mechanically arranged so as to be closed when said multi-contact switch is operated from one position to another and connected into circuit between said multi-contact switch and the other side of said source, whereby circuit is closed through one lamp which gives an authenticating signal, a third switch connected in series with said second switch and said source so as to control the connections therebetween.

6. In a cryptographing machine, means for insuring the authenticity of the message transmitted, said means comprising, a source of electricity, electric lamps each connected to one side of said source and each adapted, when lighted, to designate one character, a multi-contact electric switch connected into circuit between said lamps and operable to connect said lamps in pairs, manually operable, normally open electric switches, each connected between the other side of said source and one of said lamps, whereby, when one of said manually operable switches is closed, circuit is established through the lamp to which it is adjacent and through said multi-contact switch and another of said lamps to indicate a cipher character, a normally-closed

electric switch connected between the other side of said source and each of said lamps so as to control the connection therebetween and mechanically arranged so as to be opened when said multi-contact switch is operated from one position to another and a second switch mechanically arranged so as to be closed when said multi-contact switch is operated from one position to another and connected into circuit between said multi-contact switch, and the other side of said source, whereby circuit is closed through one lamp, which gives an authenticating signal.

7. In a cryptographing machine, means for insuring the authenticity of the message transmitted, said means comprising, a source of electricity, electric lamps each connected to one side of said source and each adapted, when lighted, to designate one character, a multi-contact electric switch connected into circuit between said lamps and operable to connect said lamps in various arrangements, manually operable, normally open electric switches, each connected between the other side of said source and one of said lamps, whereby, when one of said manually operable switches is closed, circuit is established through the lamp to which it is adjacent and through said multi-contact switch and another of said lamps to indicate a cipher character, a normally-closed electric switch connected between the other side of said source and each of said lamps so as to control the connection therebetween and mechanically arranged so as to be opened when said multi-contact switch is operated from one position to another, a second switch mechanically arranged so as to be closed when said multi-contact switch is operated from one position to another and connected into circuit between said multi-contact switch and the other side of said source, whereby circuit is closed through one lamp, which gives an authenticating signal, and a third electric switch connected on series with said second switch and said source so as to control the connection therebetween.

8. A coding device comprising, a panel having a plurality of electric-

switch-operating handles projecting therethrough, a plurality of electric switches each operated by one of said handles, a plurality of electric lights each associated with one of said handles and with a character-indicating indicia, a plurality of cryptographing rotors having stationary contacts each connected to one of said lights and having bridging contacts connecting said lights in pairs, an operator having a lost-motion connection with said rotors to move said rotors step-by-step, a source of current, a normally-closed electric switch in series with each of said handle-operated switches and said source of current, and a normally open electric switch in series with one of the stationary contacts of said rotors and said source of current, said operator acting to open said normally closed switch and to close said normally-open switch upon each step in the movement of said rotors.

9. A coding device comprising, a panel having a plurality of electric-switch-operating handles projecting therethrough, a plurality of electric switches each operated by one of said handles, a plurality of electric lights each associated with one of said handles and with a character-indicating indicia, a plurality of cryptographing rotors having stationary contacts each connected to one of said lights and bridging contacts connecting said lights in pairs, an operator having a lost-motion connection with said rotors to move said rotors step-by-step, a source of current, a normally-closed electric switch in series with each of said handle-operated switches and said source of current, a normally-open electric switch in series with one of the stationary contacts of said rotors and said source of current, said operator acting to open said normally-closed switch and to close said normally-open switch upon each step in the movement of said rotors, and a counter connected under the control of said operator so as to indicate the number of actuations of said rotors.

10. In a cryptographing machine having relatively rotary electric switches therein, means for manually rotating said switches individually so as to vary the connections therebetween, said means comprising, a finger piece arranged for

manual operation, a pivotally mounted stirrup located under the control of said finger piece, and a plurality of cam and pawl devices pivotally mounted on said stirrup and each stressed against a cam surface on one of said switches and arranged to enter one ratchet opening on said switch when not restrained by said cam surface and movable together with said stirrup to turn said switch.

11. In a cryptographing machine having relatively rotary electric switches therein, means for manually rotating said switches individually so as to vary the connections therebetween, said means comprising, a finger piece arranged for manual operation, a pivotally mounted stirrup located under the control of said finger piece, a plurality of cam-and-pawl devices pivotally mounted on said stirrup and each stressed against a cam surface on one of said switches and arranged to enter one ratchet opening on said switch when not restrained by said cam surface and movable together with said stirrup to turn said switch and tangs on all but one of said devices, said tangs each overlying the preceding device whereby one of said device is operative at each actuation of said finger piece, and each successive device can become operative only when it is permitted to do so by the cam surface which controls it and by all the preceding devices.

12. In a cryptographing machine containing a number of rotors, a latch for stressing said rotors in position comprising, a U-shaped member of spring material having one end pivotally mounted and the other end free for longitudinal movement into and out of contact with the end one of said rotors, a cam surface on said free end, and a stationary cam co-operating with said cam surface to move said free end when said latch is turned about its pivot.

13. A cryptographing, coding or ciphering machine substantially as shown and described.