April 17, 1945. E. H. HEBERN 2,373,890

CIPHER MACHINE

Filed Oct. 3, 1938 7 Sheets-Sheet 1

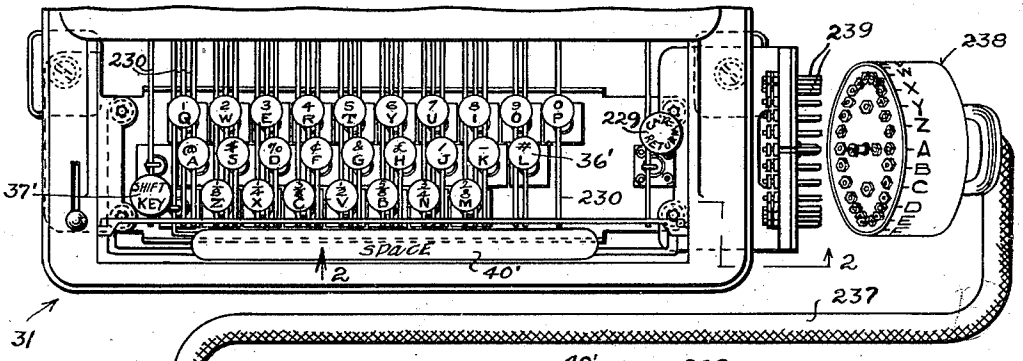


Fig. 1

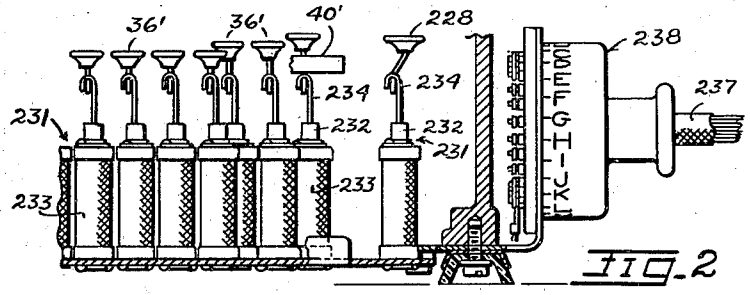
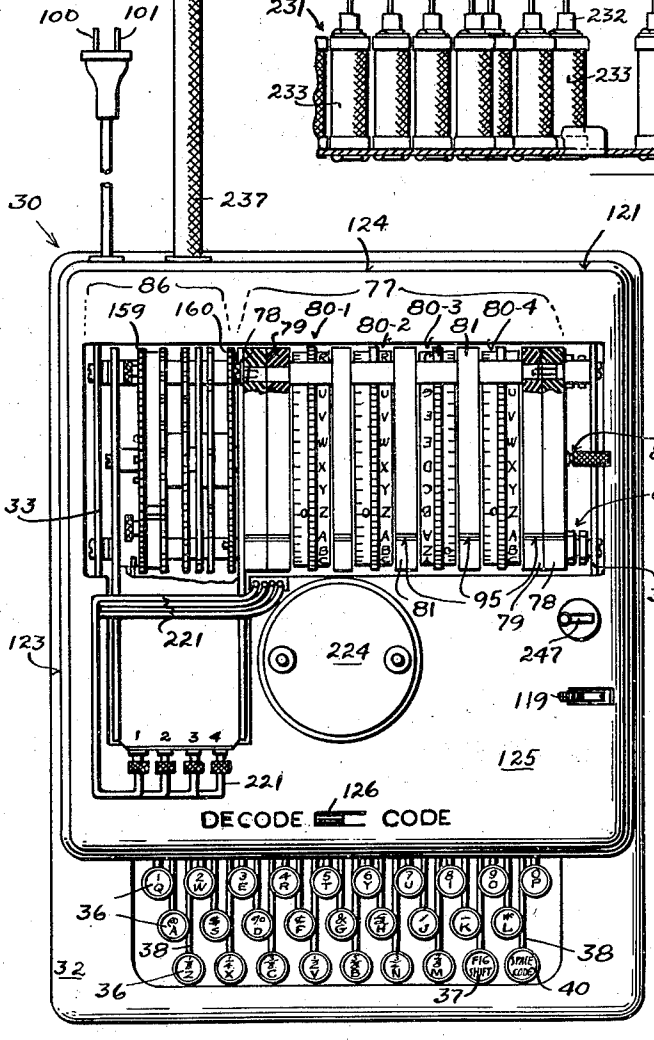


Fig. 2



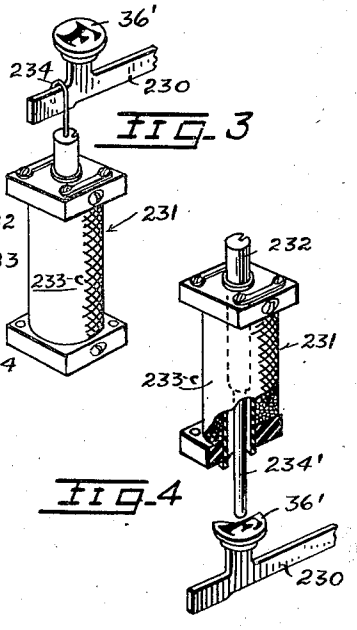


Fig. 3

Fig. 4

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FIG. 5

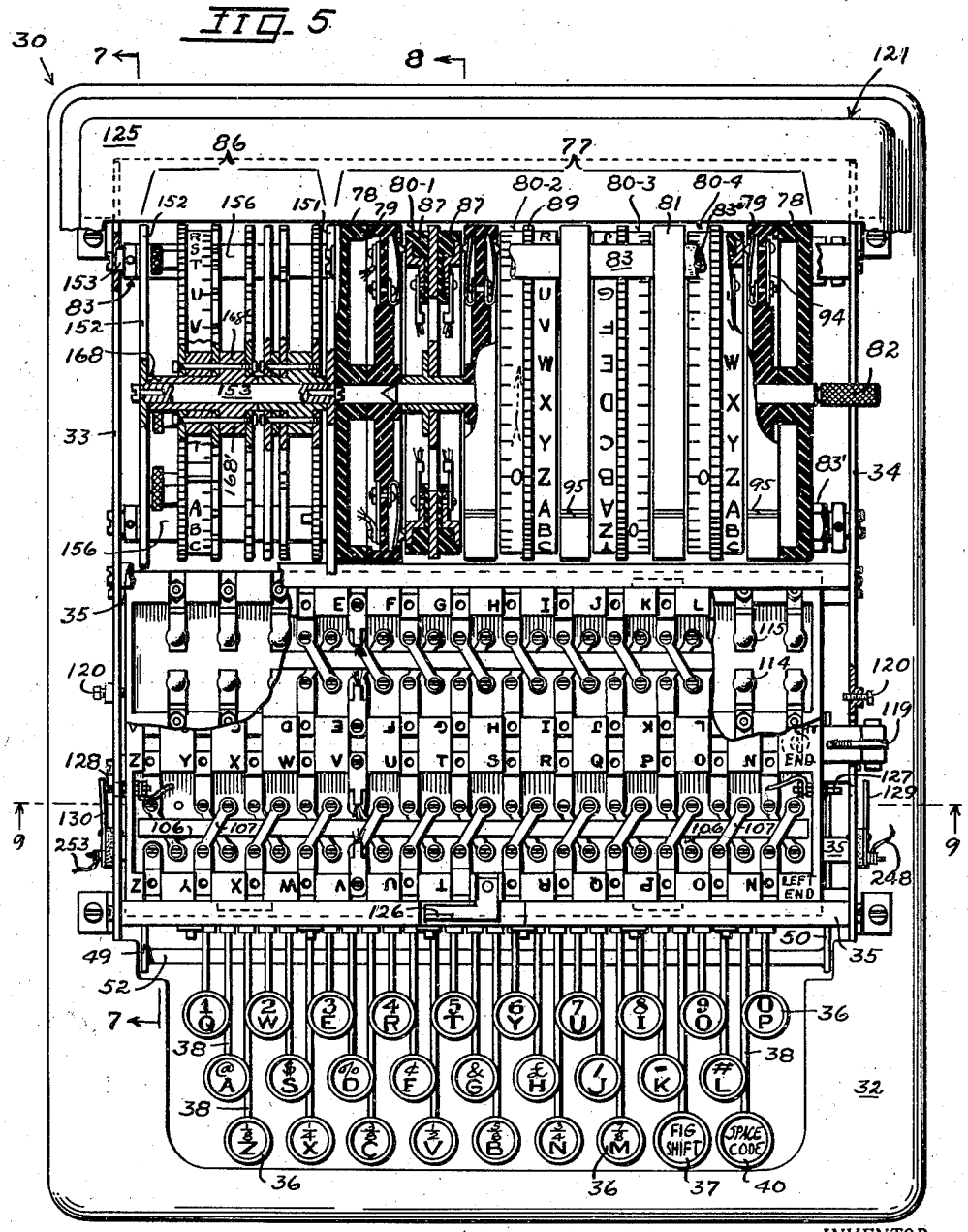
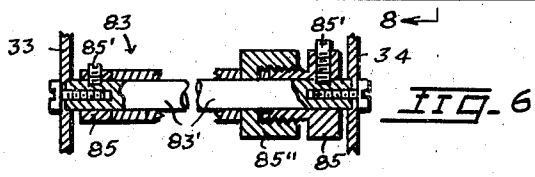


FIG. 6



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CIPHER MACHINE

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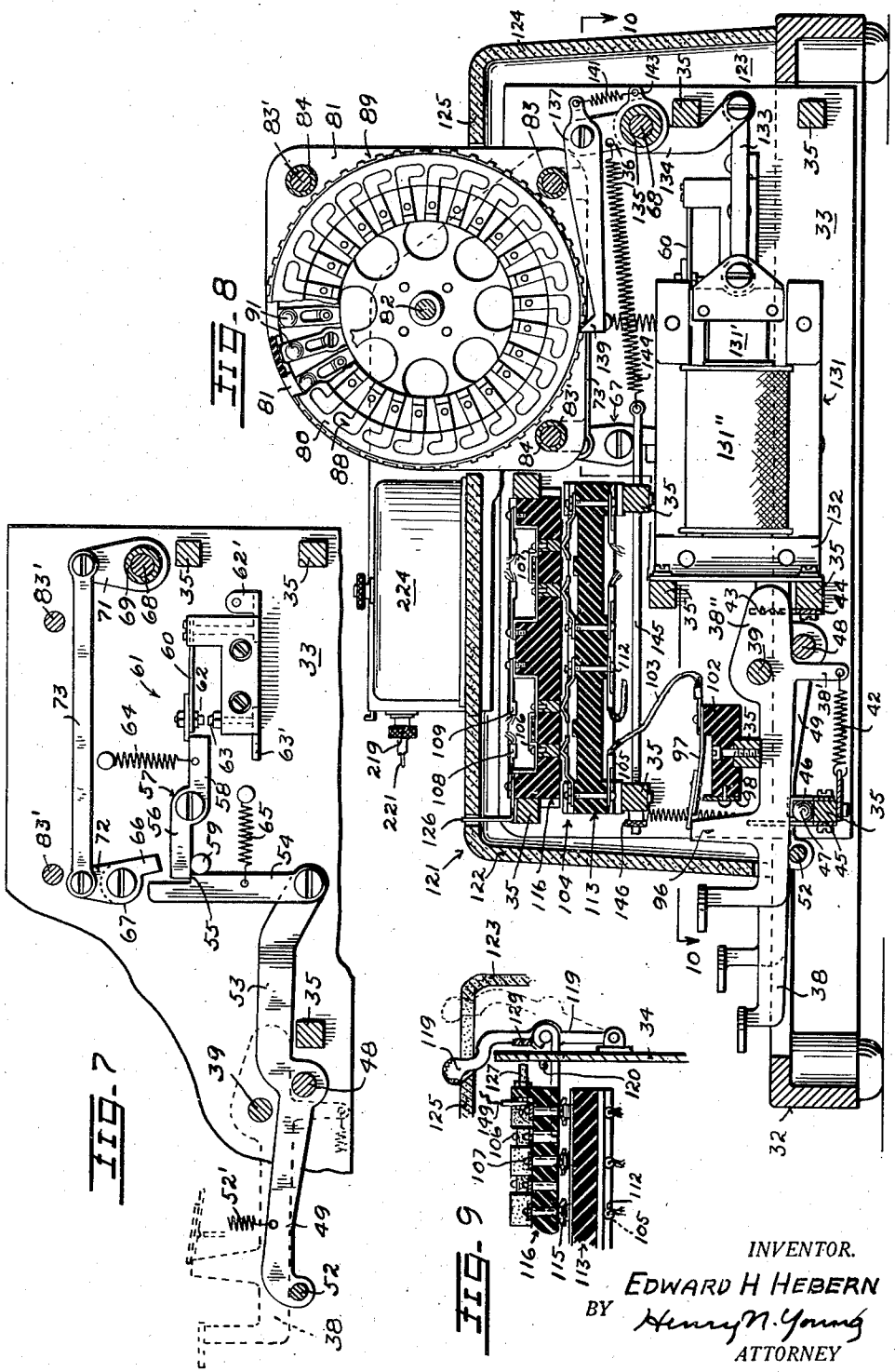

FIG. 8

FIG. 7

FIG. 9

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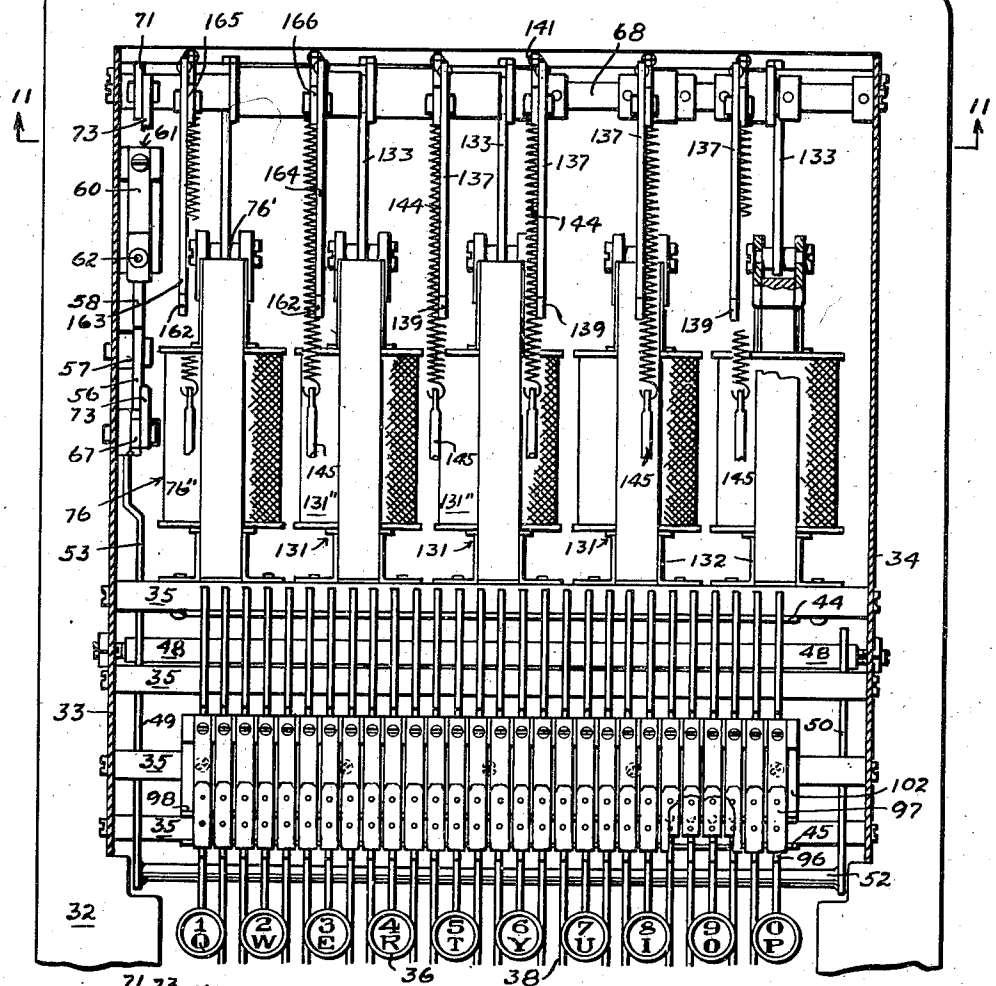
FIG. 10



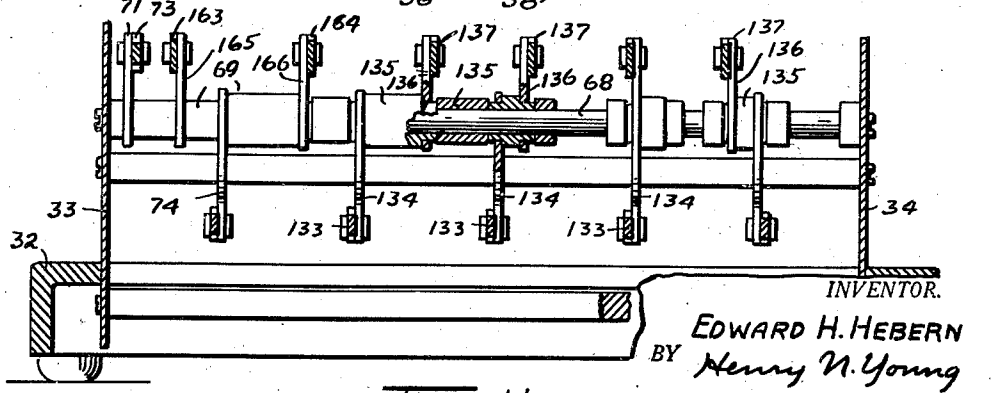


FIG. 11

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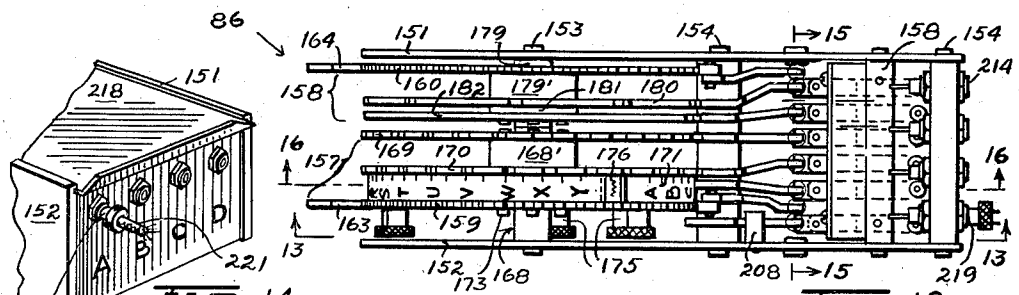

FIG. 14

FIG. 12

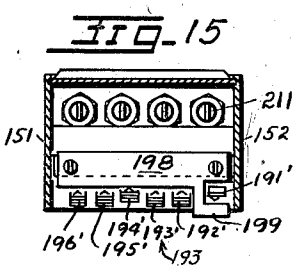

FIG. 15

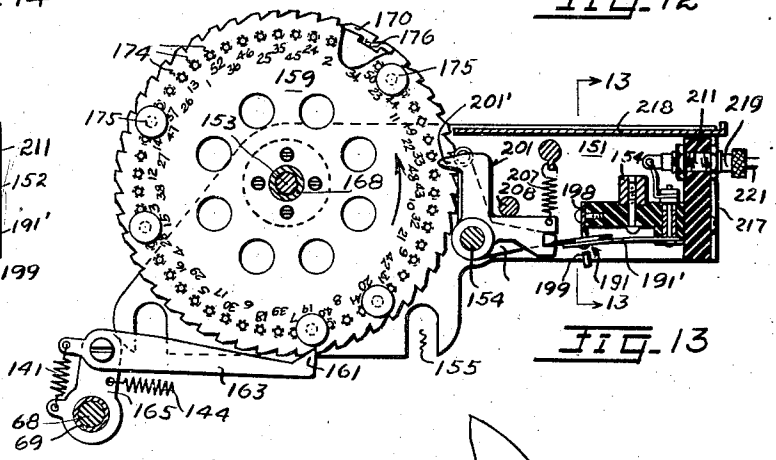

FIG. 13

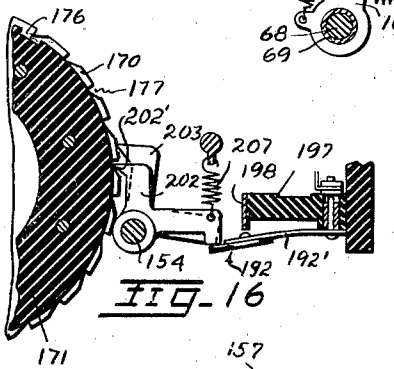

FIG. 16

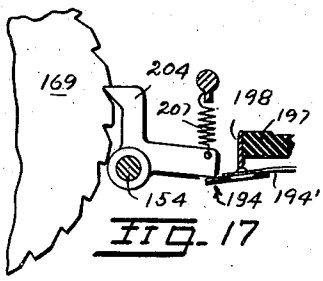

FIG. 17

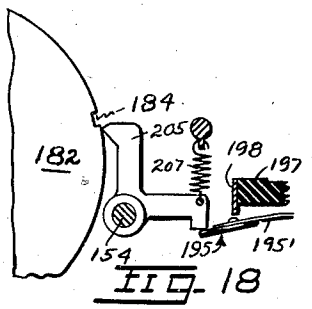

FIG. 18

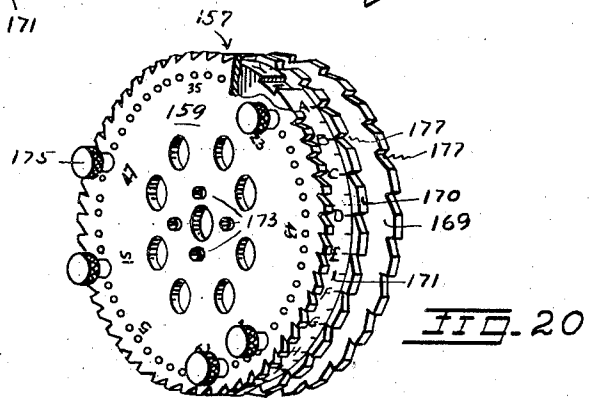

FIG. 20

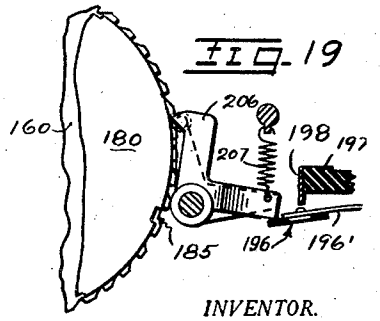

FIG. 19

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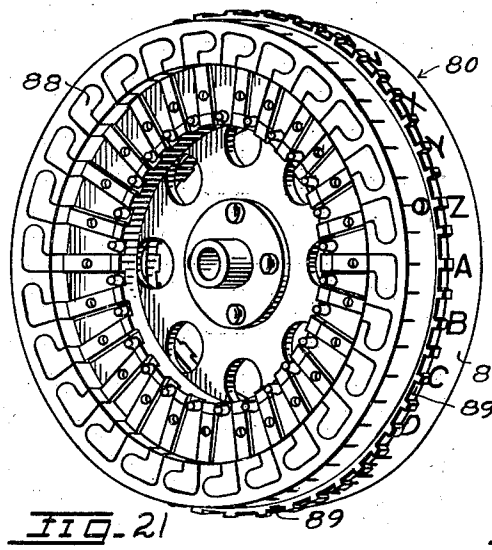

FIG. 21

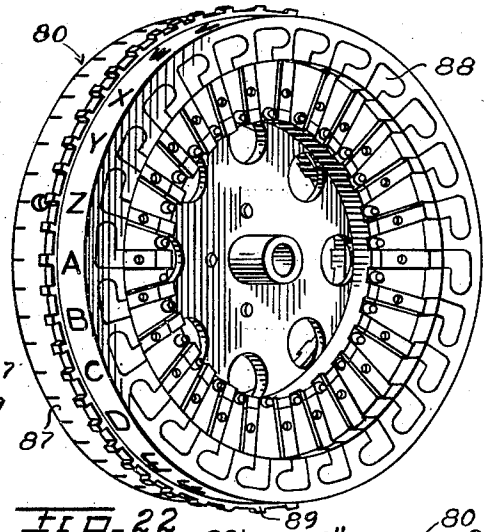

FIG. 22

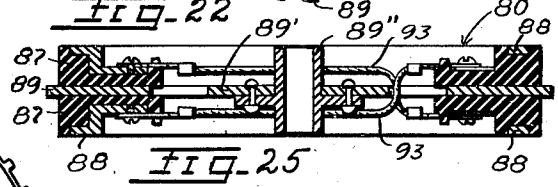

FIG. 25

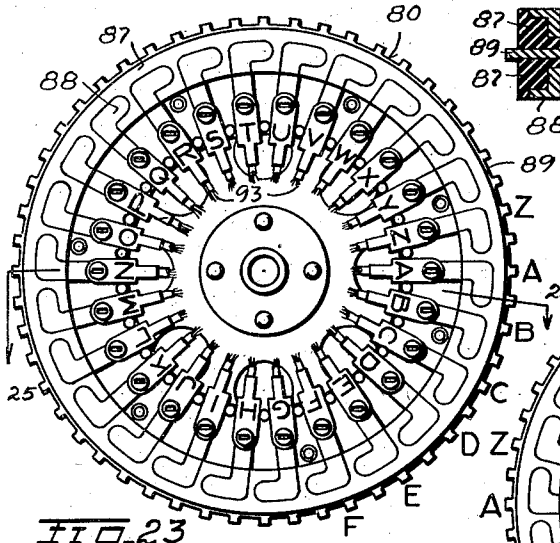

FIG. 23

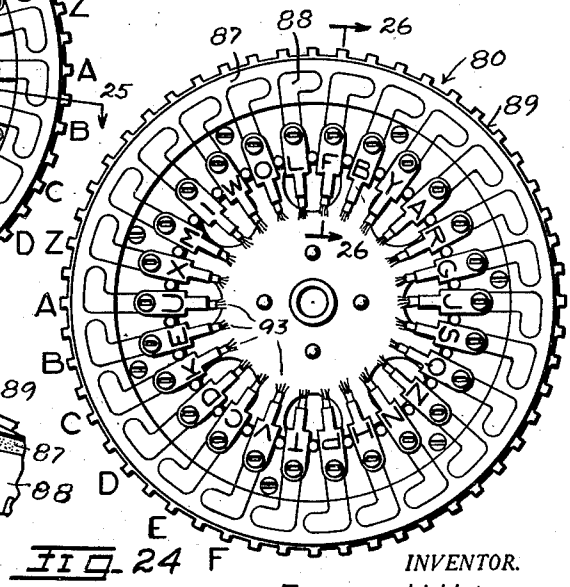

FIG. 24

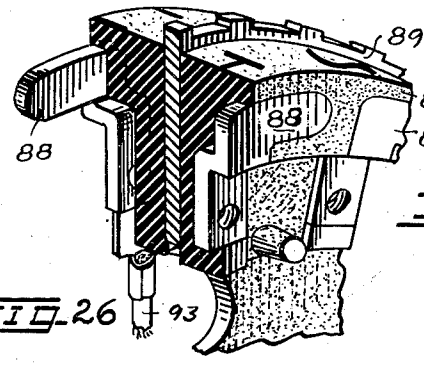

FIG. 26

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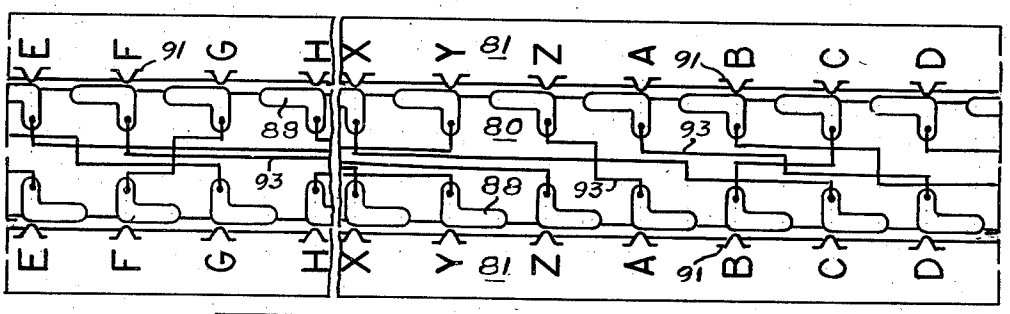

FIG. 27

FIG. 28

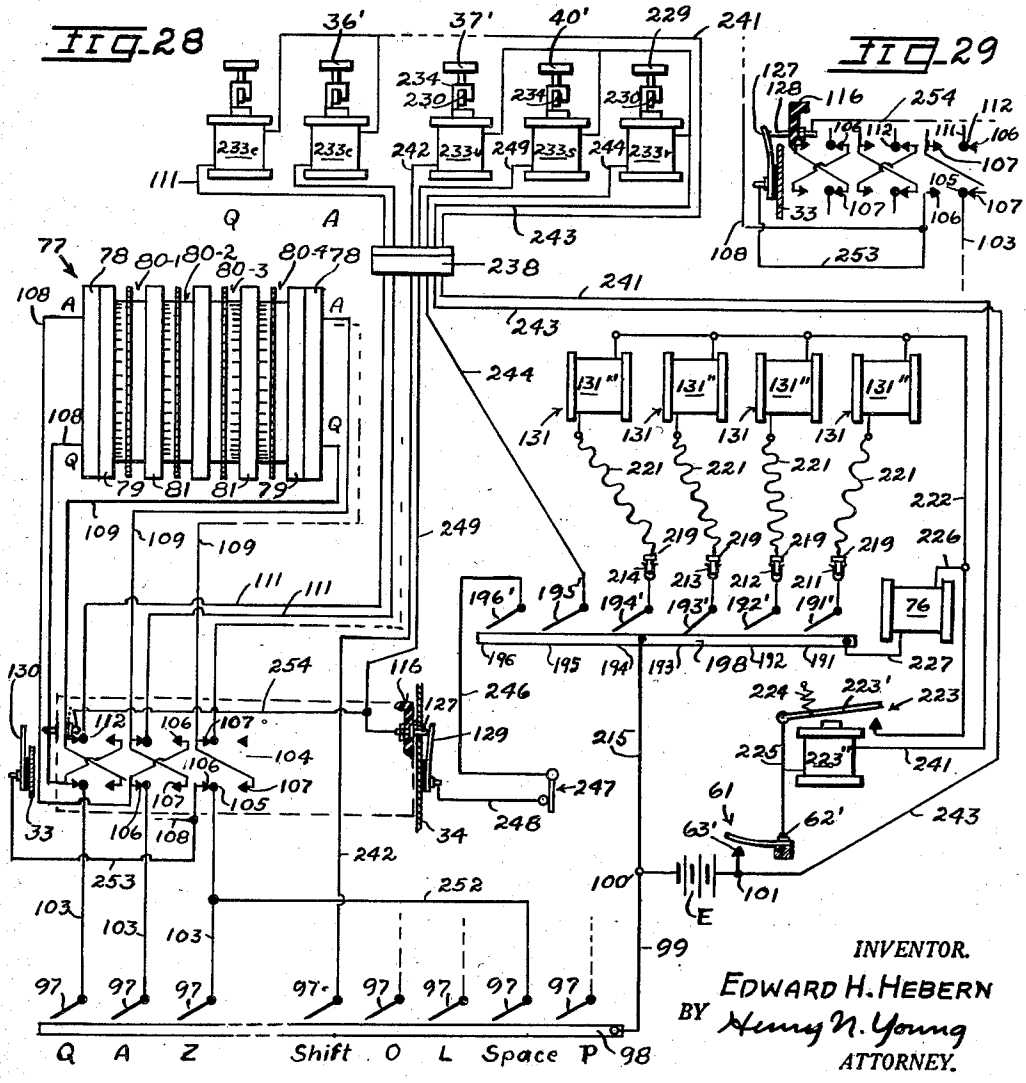

FIG. 29

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UNITED STATES PATENT OFFICE

2,373,890

CIPHER MACHINE

Edward H. Hebern, Oakland, Calif., assignor to International Code Machine Company, Reno, Nev., a corporation of Nevada

Application October 3, 1938, Serial No. 232,995

6 Claims. (Cl. 197—4)

The invention relates to cryptographic machines of the character disclosed in my United States Patent No. 1,861,857, dated June 7, 1932, and more particularly concerns devices for increasing the complexity of coding with code-changing wheels such as those disclosed in said patent.

An object of the invention is to provide a code-changing wheel which provides the operative equivalent of two complete alphabets without increasing the number of character circuits to and through the wheel.

Another object is to provide an electro-magnetic means for schematically adjusting the various code-changing wheels of a set thereof in a ciper machine.

A further object is to provide a means for secretly varying the scheme of adjustment of the code-changing wheels of a set as a further means of increasing the difficulty of deciphering a message which has been coded with the machine.

Yet another object is to provide an improved means for actuating a typewriter for printing messages as they are coded or decoded with the machine.

An added object is to provide a means whereby different characters represent spaces in a code message, yet may be automatically decoded as spaces in the decoded and printed message.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth or be apparent in the following description of a typical embodiment thereof, and in the following drawings, in which,

Figure 1 is a plan view showing a cipher machine embodying the present invention and associated with an electrically controlled typewriter for printing a coded or decoded message as the cipher machine is operated, a multiple-circuit connector being shown as disconnected.

Figure 2 is an enlarged sectional and fragmentary elevation taken at the line 2—2 in Figure 1 and disclosing an electro-magnetic means by which the keys of the typewriter are arranged to be individually actuated by character circuits controlled by the coding machine, the connector for the cipher machine being shown as engaged therewith.

Figure 3 is a perspective view showing the operative relation of a key-operating electromagnet to a keybar of the typewriter of Figures 1 and 2.

Figure 4 is a perspective view illustrating another possible relation of a key-operating electromagnet to a keybar of the typewriter.

Figure 5 is an enlarged plan view of the cipher machine, certain members of the structure being removed and others broken away.

Figure 6 is an enlarged fragmentary and sectional view taken axially of a clamping bar assembly shown in Figure 5.

Figure 7 is a fragmentary sectional elevation at 7—7 in Figure 5.

Figure 8 is a sectional elevation at 8—8 in Figure 5.

Figure 9 is a fragmentary section at 9—9 in Figure 5.

Figure 10 is a plan sectional view taken at the broken line 10—10 in Figure 8 and generally below the members shown in Figure 5.

Figure 11 is a fragmentary sectional elevation at 11—11 in Figure 10.

Figure 12 is a plan view of a unit for controlling the adjustment of the code wheels of the machine.

Figure 13 is an elevation at 13—13 in Figure 12.

Figure 14 is an outer end view of the unit of Figure 12.

Figure 15 is an elevation at 15—15 in Figure 12.

Figure 16 is a sectional elevation at 16—16 in Figure 12.

Figures 17 and 18 and 19 are fragmentary sectional elevations taken at different planes in Figure 12 to show successive switch assemblies.

Figure 20 is a perspective view of a unitary rotary assembly of Figures 5 and 12 and 13.

Figures 21 and 22 are perspective views of a code-changing wheel viewed from opposite sides thereof.

Figures 23 and 24 are opposite end face views of the code wheel of Figure 21.

Figure 25 is a section at the broken line 25—25 in Figure 23.

Figure 26 is an enlarged fragmentary and partly sectional perspective showing a portion of the structures of the code wheels of Figure 21, the section being taken at 26—26 in Figure 24.

Figure 27 is a diagram of the connections of a code wheel.

Figure 28 is a diagrammatic presentation of the electric circuits of the cipher and printing machines, the connections being shown as for the printing of a coded message.

Figure 29 shows a portion of an electric switch means and circuits shown in Figure 28, the switch elements being related as for decoding.

The present cipher machine 30 is arranged for operation in response to the selective actuation of keys in the general manner of a typewriter to code or decode a message and appropriately actuate a printing or typewriting machine 31 which

is provided as a separate unit and is electrically actuated from the machine 30. The mechanism of the latter machine is mounted on a frame which comprises a base member 32 of rectangular outline enclosing and supporting complementary and transversely spaced side plates 33 and 34 which are rigidly connected by a plurality of spacer bars 35, certain of said bars being further utilized in connection with the machine mechanism as will be brought out. An array of three rows of keys for selective depression is provided at a keyboard portion of the frame forwardly of the front edges of the frame sides 33 and 34.

As shown in Figures 1 and 5, the keys at the keyboard include twenty-six character keys 36 each representing a different letter of the English alphabet and also a numeral or punctuation mark or some other character of a second set of characters. The keys 36' of the typewriter 31 correspond to the keys 36 of the unit 30, and the printing of one or the other of the two characters represented by a particular key 36 is determined by the position of a usual paper-carrying carriage (not shown) of the unit 31; when the carriage is in a normal lowered position thereof, the alphabet characters are printed, and the characters of the other set may be printed when the carriage is in the raised position therefor. As is usual, the carriage of the typewriter 31 would be controlled by an escapement to release the carriage for its movement through the space of a character after a character has been printed.

A suitable means (not shown) is provided in the unit 31 for raising its carriage for printing characters of the second set, and a key 37 is provided at the keyboard of the unit 30 for actuation to operate the carriage shifting key 37' of the typewriter 31 to effect a raising of the carriage when desired. Said second set of characters might, of course, be alphabet letters of another real or imaginary language. A character-spacing key 40 is also provided at the keyboard of the cipher machine 30, while a corresponding key 40' is provided at the keyboard of the typewriter 31.

By particular reference to Figures 7 and 8 and 10, it will be seen that the keys 36 and 37 and 40 are carried at the forward ends of and generally above keybars 38 which pivotally engage a common shaft 39 which is fixed to and between the frame sides 33 and 34 at the general level of the keys, and is parallel to the front line of the unit. As shown, each keybar comprises a flat strip of metal having an ear portion 38' extending radially downwardly of its pivotal axis and having its extremity connected by a tension spring 42 with a frame bar 35 which underlies the keybars 38, said spring being constantly operative to urge a raised positioning of the keybar to engage an overlying frame bar 35 as a stop means for the keybar.

In the present instance, each keybar 38 has a rearward extension 38'' which engages a slot 43 provided in a plate member 44 which is fixed in upright position to a frame bar 35 which underlies the extension. The frame bar 35 which provides the anchorage for the springs 42 carries a slotted plate 45 similar to the plate 44, with said bar operative as a stop to limit the downward swinging of the keybars. It will be noted that the keybar-receiving slots of the plates 44 and 45 are evenly and similarly spaced along the plates, extend to the top plate edges, and function as a guiding and positioning means for the keybars in their places.

Means are provided to prevent the depression of more than one of the keys 36 and 40 at a time; as shown, a laterally slotted angle plate 46 is mounted on the bar 36 which mounts the plate 45 for cooperation with the bar and plate to provide an elongated space of uniform cross-section, said space being closed at its ends and containing a plurality of balls 47 of such diameter that the keybar 38 of only one of the keys 36 and 40 may be depressed through their line at any time. The under edge of the keybar 38 for the shift key 37 is notched out or otherwise formed above the line of the balls 47 whereby the depressing of this keybar is permitted without engaging the balls beneath it; in this manner, the selective depression of the remaining keybars is permitted for effecting the printing of characters of either set, since the depression of the keybar for the shift key 37 does not spread the balls in their line.

A shaft 48 is journalled in and between the frame sides 33 and 34 in parallel relation to the keybar pivot shaft 39. Arms 49 and 50 extend forwardly from the shaft 48 in mutually coplanar relation, are rigidly fixed to the shaft, and carry a straight bar 52 in and between their front extremities. The bar 52 is arranged to normally engage the under edges of all of the keybars 38 except that for the shift key 37 by the action of a tension spring 52' which is operative between a forward point of the arm 49 and an overlying frame bar 35. When a keybar for the keys 36 or 40 is rocked against the resistance of its spring 42 and the spring 53, the rigid frame which is provided by the shaft 48 and the arms 49 and 50 and the contact bar 52 is rocked to rotate the shaft 48 and effect an upward swinging of an arm 53 which extends generally horizontally from the shaft at the opposite side from the frame arms; in the present instance, the arm 53 comprises an integral extension of the arm 49.

A thrust bar 54 extends upwardly from a pivotal connection with the arm 53, and its rear edge is stepped to provide an upwardly facing shoulder 55 for normal positioning beneath the forward arm 56 of a lever 57 which is pivoted to the frame end 33 and is substantially perpendicular to the bar 54. The other arm 58 of the lever 57 is arranged for movement against a spring contact arm 60 of an electric switch 61 to dispose the contact 62 of the arm 60 out of engagement with a fixed contact 63 of the switch assembly. The switch contacts 62 and 63 are suitably insulated from each other and the frame and the lever arm 58 for the connection of the switch 61 in an ungrounded circuit; as shown, the switch parts are mounted on a support of insulating material which is fixed on the plate 33 and mounts terminals 62' and 63' connected with the contacts 62 and 63 respectively for their use in connecting the switch 61 in a circuit.

A tension spring 64 is normally operative between the lever arm 58 and an anchorage on the plate 33 to overcome the resilient resistance of the switch arm 60 to open the switch 61 and engage the arm 56 against a stop pin 59 which underlies the outer arm end and extends from the plate 33. When the shoulder 55 of the bar 54 is raised beneath the end of the lever arm 56 to sufficiently rock the lever 57, the spring arm 60 of the switch 61 is permitted to engage its contact 62 with the contact 63 and so close the switch thereat. A tension spring 65 is normally operative against the bar 54 to engage the rear face of the bar below the shoulder 55 with the stop pin 59, the rear face portion of the bar 54

above the shoulder being held clear of the opposed end of the lever arm 56. It will be understood that the described arrangement is essentially a means to permit a closing of the switch 61 each time a keybar 38 is rocked from its normal position by the full depression of its key.

It will now be noted that the circuit including the switch 61 is that which controls the rotary adjustment of a plurality of code-changing wheels of the coding and decoding mechanism of the unit 30 through the energizing and actuation of an electromagnet means which is arranged to effect the operations of pawls against ratchet teeth of the wheels to reset one or more wheels after the temporarily closed circuit thereof has been opened. Since holding down a character key would prevent a completion of the desired action until the key is released, means are provided for automatically opening the control circuit after the electromagnet means has been actuated and independently of the disposition of the actuating key, said means effecting a rocking of a lever 67 pivoted on the plate 33 to apply a depending lever arm 66 laterally against the upper end of the operative bar 54 to swing the latter forwardly and release the arm 56 of the lever 57 to permit a reopening of the switch 61 through the action of the spring 64.

A shaft 68 is fixed in and between the plates 33 and 34 near the rear edges thereof and revolubly mounts a hub member 69 at its portion nearest the plate 33. An arm 71 extends upwardly and fixedly from the hub 69 and has its free end connected to the free end of an upwardly extending arm 72 of the lever 65 by means of a link 73 which is pivoted to both arms. The hub 69 is provided with a depending arm 74 which is fixed thereto and has its free end linked to the armature 76' of an electromagnet 76, said armature comprising a movable magnetic core for the solenoid 76'' of the electromagnet and being normally extended from the core bore in which it is slidable for its axial movement within the bore when the coil 76'' is energized. The coil 76'' is connected in the same circuit with the switch 61, and the rocking of the hub 69 which is caused as the armature 75 is displaced by the energizing of the coil is arranged to operate through the link 73 to rock the lever 67 to displace the arm 54 to free the lever 56 and so open the controlling circuit at the switch 61 in the described manner and just as the inward stroke of the armature is completed. It will be noted that the return movement of the arm 66 permits the engagement of the rear face of the arm 54 below the shoulder 55 to engage the lowered extremity of the lever arm 56 until the bar is lowered to dispose the shoulder below said arm. With the described arrangement, the continued operation of the code wheel control in a cycle of operations thereof is independent of the disposal of a control key which was originally depressed to initiate the cycle.

A unitary code wheel assembly 77 is mounted at and across an upper portion of the frame of the cipher machine 20. As is particularly brought out in the assembly showings of Figures 1 and 5, the assembly 77 comprises end plates 78, brush-carrying plates 79 engaging each of the end plates 78, four similar code wheels 80 rotatably mounted between the plates and individually numbered 80—1 and 80—2 and 80—3 and 80—4 for any necessary differentiation, and three similar brush-carrying plates 81 alternating with the successive code wheels in the line thereof. The elements 80 are cylindrical in outline and are provided with axial bores for receiving a shaft 82 for their mutually independent rotative adjustments about the shaft, said shaft engaging complementary bores provided in the various plate members 78 and 79 and 81 to provide a fixed alignment of the various members of the assembly and provide for the rotation of the elements 80 in their places. The shaft 82 is mounted for its removal axially thereof from an unobstructed end of the assembly 77.

The various plate members 78 and 79 and 81 all have corresponding portions thereof extending radially beyond the elements 80, and clamp assemblies 83 including spacer sleeves 84 of appropriate lengths to properly space the plate members are engaged through said extending plate portions for securing the plates in mutually spaced relation while providing for the rotation of the elements 80 in their places. As particularly shown, two lower assemblies 83 extend through and between the frame plates 33 and 34 for mounting the code wheel unit 77 on the frame, and these assemblies also mount and clamp in place a unitary assembly 86 for controlling systematic adjustments of the code wheels 80 in a manner to be hereinafter described. The assemblies 83 are so disposed that the code wheels released by the removal of the shaft 82 may be removed for reversing them in place and/or varying their order in the code wheel assembly, or replacing one or more of them with other wheels of different internal arrangement of conductors.

By reference to Figures 1 and 5 to 8, it will be noted that each clamp assembly 83 includes a rod 83' having its ends fixed to the extreme elements to be connected. As shown in Figure 1, the upper rod 83' has its extremities engaged in complementary sockets provided in the plates 78 and secured in place by screws extending axially into the rod ends through the plates. Each of the lower rods 83' has its extremities seated in complementary sockets in the plates 33 and 34, and is secured to the plates by screws extending through the plates into threaded axial bores in the rod ends, the structure and relations being shown in Figure 6. Collars 85 are adjustably fixed by setscrews 85' on the lower rods 83' opposite the outer elements of the units 77 and 86 to be fixedly mounted in place on the machine 30, and at least one collar 85 threadedly carries a thrust ring 85'' for movement against the opposed element and toward the other collar to clamp the assembly of engaged and intervening elements in place; in this manner, the units 77 and 86 are adjustably mounted and releasably fixed between the frame sides, namely, the plates 33 and 34.

It will now be noted that the present code wheel assembly 77 is in general accord with that disclosed in my before-mentioned U. S. Patent No. 1,861,857, and that the present arrangement includes certain modification and improvements which are effective to provide a coded message which is still more undecipherable than before to a person not possessing a present cipher machine and/or not knowing the required initial setting. By particular reference to Figure 5 and Figures 21 to 26 inclusive, it will be seen that each code wheel 80 comprises a pair of annular rings 87 carrying mutually insulated contacts 88 at their outer faces and secured to opposite faces of a ratchet wheel 89 comprising a peripherally toothed flat ring 89' fixed to a tubular hub 89'' which is arranged to receive the pivot shaft

82 for rotation thereabout. The wheel 89 may be of metal, and the rings 87 are preferably molded of an electrically non-conducting material having contacts 88 embedded therein during their molding to have their exposed faces flush with the outer ring faces thereat.

The contacts 88 of each ring 87 are equally spaced in a circle which is concentric with the axis of the shaft 82, are twenty-six in number, and are normally in simultaneous engagement with spring contact brushes 91 which extend from the opposed faces of the plates 79 and 81. As shown, the brushes 91 comprise spring arms extending radially outwardly from secured inner ends thereof and having their free ends arranged for simultaneously engaging the opposed faces of the contacts 88 in their line. Each contact 88 of a ring 87 of a code wheel 80 is connected by means of an insulated conductor 93 with a contact 88 of the other ring 87 of the wheel structure, the ratchet wheel portion 89' between the rings and the hub 89'' being transversely perforated to permit this. It will be understood that the connections through the code wheels may be made in a great number of different combinations whereby such different combinations in themselves comprise a code-varying device, as is brought out in my said previous patent.

In the present code wheel structure, each contact 88 is elongated in its line, and the two sets of contacts on each code wheel 80 are so related that an axial line through the forward end portion of one contact extends through the rearward end portion of a contact at the other side of the wheel, the line being one through mutually opposite contact points of the brushes 91 when the wheel is in a set position thereof. In this manner, when a brush 91 moves from one contact point of a given contact 88 to the other contact point thereof, different connections are provided through the wheel. Accordingly, the present code wheels 80 are each provided with fifty-two ratchet teeth whereby one revolution of a wheel is the coding equivalent of two revolutions of a code wheel having contacts which are engaged successively with a given brush. Besides reducing the rotary movement which is required for a changed setting of a code wheel, the present arrangement markedly increases the undecipherability of a coded message in terms of the number of wheels in the code wheel assembly, it being understood that such a number may be one or more in accordance with the use requirements of a particular situation.

It will be noted by reference to Figure 5 that corresponding brushes 91 at opposite sides of each brush plate 81 are electrically connected by a rivet or the like which secures the brushes in place. Also, securing bolts for the brushes of the plates 79 extend through these plates to individual terminal plates 94 for connection in different character circuits which are to control the actuation of the typewriter 31. Preferably, and as shown, each end plate 78 of the code wheel assembly is hollowed out at the face thereof which opposes the adjacent brush plate 79 whereby to provide a space for the wire connections to and from the terminals 94.

The described connections within the code wheel assembly 77 are understood to provide twenty-six closed electrical paths therethrough, said paths being varied each time one or more code wheels 80 is rotatively adjusted through the angle of adjacent ratchet teeth thereof. For reference, the connectors 94 may be lettered in terms of their connections with sending keys and the keys of a printing machine; for example, the connector "A" of the left-side plate 79 might be connected with the "A" circuit of the cipher machine 30, while the connector "Q" of the right-side plate 79 might be connected with the "Q" circuit of the typewriting or printing machine 31. Should it happen that said "A" and "Q" connectors are joined through the code wheel assembly 77, the character Q would be printed for A when the "A" key 36 is struck, this being assumed in the diagram of Figure 28. If now, the connections provided at the connectors 94 are reversed with respect to the two machines, the striking of the letter Q at the cipher machine keyboard will print the letter A which was originally coded to the letter Q; it will thus be understood that the provision and use of a set of reversing switches and the setting of the code wheels is all that is needed for effecting coding and decoding of the same message with the present equipment, it being noted that the peripheries of the code wheels 80 carry the letters of the alphabet opposite alternate ratchet teeth for use as indicators in setting the wheels at the start of coding or decoding a message with respect to a reference mark 95 which is provided across the fronts of the fixed plates 78 and 79 and 79 of the code wheel assembly 77.

It will now be noted that the depression of a particular character key 36 to rock its keybar 38 for effecting the closing of the switch 61 is arranged to simultaneously close a normally open circuit through the code wheel assembly 77 for that character only. As shown in Figures 8 and 10 and 28, a projection 96 extends upwardly from each keybar 38 to normally engage a spring switch arm 97 to hold the same out of contact with a fixed and elongated conductor element 98 which underlies the spring arms 97 for all of the keybars and is connected by a conductor 99 with a terminal 100 of an electric power source E such as an electric battery, the other power terminal being designated by the numeral 101. The arms 97 for the keys 36 and the common contact 98 are understood to provide a multiple switch for controlling parallel branch circuits for the different characters, and these elements are shown as mounted on a base which comprises a bar of insulation material which is in turn mounted on the frame bar 35 which acts as the stop to limit the upward swinging of the keybars.

The various switch arms 97 for the keys 36 are each connected by independent conductors 103 with the input terminal 105 of a reversing switch 104 which provides connections for either coding or decoding a given letter with the same or like cipher machines. Connected pairs of reversing contacts 106 and 107 of each switch 104 are respectively connected with terminals 94 of the different end plates 79 of the code wheel assembly 77 by means of conductors 108 and 109, and an output conductor 111 leads from the output terminal 112 of each switch 104 to a connection with a different key-operating means for the printing machine 31. As is particularly shown in Figures 5 and 8 and 9, the switch input and output terminals 105 and 112 respectively are provided at the under side of a plate member 113 which is fixedly supported on a pair of the frame bars 35 which are disposed forwardly of the code wheel assembly 77. The terminals 105 and 112 are respectively connected through the member 113 with sets of spring contacts 114 and 115 which tend to extend upwardly from the member, with the contacts of each set arranged in two parallel

rows of thirteen each and equally spaced in their rows.

A plate member 116 is slidably supported above the fixed plate member 113 for its limited movement in a direction parallel to the rows of spring contacts 114 and 115 of the latter, said member being laterally guided in its movement between an upper pair of the frame bars 35. The member 116 carries contacts 106 and 107 equally spaced in rows thereof overlying the lines of the spring contacts 114 and 115 respectively and the member 116 is supported on said contacts whereby either set of alternate contacts 106 and 107 of each row may simultaneously engage the spring contacts 114 and 115 of their rows. Terminals for connecting the conductors 108 and 109 with the contacts 106 and 107 are provided at the upper side of the member 116, and each said terminal is connected with contacts 106 and 107 in adjacent rows thereof which are opposite the spring contacts 114 and 115, the arrangement being such that the latter contacts engage the terminals 106 and 107 respectively when the member 116 is in decoding position thereof, as in Figures 5 and 8 and 9 and 10 and 29, and are connected with the terminals 107 and 106 respectively when the member 116 is in its coding position as in Figure 28. A generally erect arm 119 is pivoted on the wall 34 for its movement in an upright plane parallel to the lines of the reversing switch contacts, and is connected with the opposed end of the member 116 for its use in moving the member between limiting positions determined by adjustable stop members 120 mounted on the plates 33 and 34, whereby to respectively provide the switch connections for coding and decoding with the present cipher unit.

A unitary casing member 121 having a front wall 122, side walls 123, a back wall 124, and a top wall 125 is mounted on the frame base 32 for generally enclosing the described mechanism. The top wall 125 of the casing 121 is disposed at a level below the rotary axis of the code wheel assembly and is slotted across its width in the line of said assembly to permit the protrusion of the latter. A slot in the top casing wall 125 receives the setting arm 119 of the described multiple reversing switch for its manual engagement to shift the member between its limiting positions which are determined by its engagement with the members 120. A pointer 126 extending upwardly from the member 116 through an overlying slot in the casing top 125 provides an indication as to the setting of the member 116 at any time.

The movable reversing switch member 116 carries electrical contacts 127 and 128 extending from opposite ends of the member and selectively engageable with spring contacts 129 and 130 respectively mounted on the plates 34 and 33, as the member is disposed for a coding or decoding use of the machine. The single-pole switches 127—129 and 128—130 thus provided are respectively operative in circuits which cause the printing of a character for a message space in the coded message, and cause the provision of a space for each code character which represents a space in the original message when decoding is effected, the specific control being hereinafter described.

Recalling that one or more of the wheels 80 are to be reset between the printing of successive coded or decoded characters, and that my beforementioned patent provided for an automatic and progressive setting of a set of code wheels mechanically, and in an unchangeable order, an improved means is provided for secretly varying to a substantially unlimited degree the particular order in which the various code wheels are advanced as a message is coded or decoded. The present means is electrical and essentially provides a control for independently operative electromagnets 131 having armatures 131' which actuate dogging hooks or pawls teeth of the code wheel ratchets 89 to rotatively advance the same each time the solenoid 131'' of an electromagnet 131 is operative to move its armature out of its normal position.

By reference to the drawings, and particularly to Figures 8 and 10 and 11, it will be noted that four electromagnets 131 are mounted in a common plane below the different code wheels and the level of the shaft 68 with their axes parallel to the planes of the code wheels. The armatures 131' extend rearwardly from the solenoids 131'' and are suitably guided for their rectilinear reciprocation in the solenoid bores. Brackets 132 mount the electromagnets 131 in fixed position on a pair of spacer bars 35. As illustrated, the structure and mounting of the electromagnet 76 is the same as that of the electromagnets 131, the former is mounted similarly in the same plane and line with the latter, and the mutual spacing of the electromagnets in their line is uniform.

Links 133 connect each armature 131' with the lower end of an arm 134 which depends from a sleeve member 135 which is rockably mounted on the shaft 68, the sleeves being mutually independent and disposed along the shaft to position the arms 134 for action in the lines of the armatures 131'. Arms 136 extend upwardly from the sleeves 135 in fixed angular relation to the arms 134, and pivotally carry levers 137 having pawl arm portions extending forwardly of their pivot points and terminating in pawls 139 which are arranged to normally engage between teeth of the ratchets 89 of the various code wheels through the action of tension springs 141 which are operative between the rearward lever portions and radial ears 143 extending generally rearwardly from the sleeves 135. A tension spring 144 extends forwardly from each arm 136 to a connection with the rear end of an anchor rod 145 which is slidably engaged through the frame bars 35 which support the reversing switch base 113 and threadedly carries a nut 146 which bears against the forward supporting bar 35 to provide for an adjustment of the tension of the spring 144. The spring 144 is normally operative to engage the arm 134 with the rearward frame bar 35 as a positive stop and a positioning means for the associated pawl 139.

In the present instance, the pawls 139 are each so shaped that their rearward movements permit their swinging radially over the ratchet tooth immediately to the rear thereof to engage its point behind said tooth, whereby a return movement of the pawl may rotate the ratchet and its code wheel through the angle between adjacent teeth. This action of a pawl results each time an electromagnet 131 is energized to displace its armature from its normal position in which it is yieldingly held by the spring 144, and any adjustment of the engaged code wheel occurs after the depression of a key 36 and following the transmission and termination of the coded impulse through the code wheel assembly to actuate a key 36' of the typewriter 31. While the friction of the contact brushes 91 with the opposed code wheel contacts 88 may generally be relied on to secure the code wheels against a backward rotation when a pawl 139 is pulled rearwardly under a ratchet

wheel tooth which it contacts, it will be understood that an oppositely acting pawl might be provided for the purpose, such a pawl being releasable when a code wheel is to be set in an initial ciphering position.

The unit 86, it will now be noted by reference to Figures 5 and 12 to 20 inclusive, comprises a pair of opposed and transversely spaced similar plates 151 and 152 which are held in parallel relation by a fixed shaft member 153 and spacing bars 154. Mutually aligned notches 155 are provided in and across the bottom edges of the plates for fittedly receiving the two bottom clamp elements 83 therein, suitable spacing sleeves 156 being mounted on the elements between the plates 151 and 152 and at the outer sides of the plates whereby a tightening of the thrust rings 85' of said clamp elements may releasably secure the unit 86 in place without crushing it. When the unit 86 is mounted in the position shown, the shaft 153 thereof is arranged to be in axial alignment with the shaft of the code wheel assembly as is shown in Figure 5.

The shaft 153 rotatably mounts two unitary assemblies 157 and 158 which are arranged to be independently rotated through small angles each time the electromagnet 76 is energized by reason of the closing of the switch 61 and a switch 97—98 when a key 36 is actuated. As is brought out in the drawings, the assemblies 157 and 158 respectively include ratchet wheels 159 and 160 which are in the form of flat and centrally perforated discs, and are arranged for simultaneous one-way rotative adjustments through the actions of pawls 161 and 162. As is shown in Figures 10 to 13, the pawls 161 and 162 are provided at the forward ends of levers 163 and 164 independently pivoted to the upper ends of arms 165 and 166 extending radially upwardly from the hub 69 which is rocked by the electromagnet 76 each time the switch 61 is closed to energize the electromagnet. Springs 141 and 144 are respectively operative against the arms 165 and 166 and against the pawl levers 163 and 164, as in their applications to the levers 137 and the arms 136, whereby the pawls 161 and 162 are arranged to operate against the teeth of the engaged ratchet wheels in the same manner as the pawls 139 operate against the ratchet teeth of the code wheels.

It will now be noted that the assembly 157 comprises a hub member 168 which is rotatably mounted on the shaft 153, has an intermediate radial flange 168', and carries circular discs 169 and 170 fixed against opposite sides of its flange 168'. A cylindrical member 171 has an end engaging the disc 170 at its face opposite from the flange 168', and has the ratchet disc 159 engaged against its other face. Bolts 173 engage through the ratchet disc 159, the member 171, the disc 170, the flange 168' and the disc 169 for unitarily fixing the various elements together to provide the assembly 157.

The exposed face of the ratchet disc 159 is provided with a circle of fifty-two cylindrical openings or sockets 174 which are preferably marked in random order for their identification and are arranged to receive and frictionally retain the shanks of headed pins 175 in variable number and arrangement, the shank portions of the mounted pins being exposed between their heads and the opposed disc face, and the disc periphery is provided with fifty-two equally spaced ratchet teeth for operative engagement by the pawl 161. The member 171 bears indicia for the twenty-six letters of the English alphabet in order about its periphery and is provided with one transverse notch 176 in said edge, preferably at the position of the character Z. The discs 169 and 170 are of like size and are each provided with twenty-six notches 177 in their peripheral edges, said notches being relatively staggered peripherally of the two discs, as is brought out in Figures 12 and 20.

The assembly 158 comprises a hub member 179 rotatably mounted on the shaft 153 and having an intermediate radial flange 179', and carries the ratchet disc 160 against one side of the flange. A circular disc 180 engages the other side of the flange 179' and is followed by a spacing ring and a circular disc 182 in order. Screw bolts engage through the disc 182, the spacing ring, the disc 180, the hub flange 179' and the ratchet disc 160 for unitarily fixing the various members together to provide the assembly 158. The periphery of the ratchet disc 160 is provided with fifty teeth for operative engagement with the pawl 162, and the periphery of the disc 182 is provided with a single notch 184. The periphery of the disc 180 is provided with a succession of nine notches 185 which are thirty-six degrees apart whereby the end notches of the line are seventy-two degrees apart in the peripheral circle, and the disc 180 is so set with respect to the disc 182 that the center of its seventy-two degree gap on the line of notches 185 is positioned axially of the notch 184 of the disc 182. The hubs 179 and 168 together occupy the space between the plates 152 and 153 of the unit 86 whereby the assemblies 157 and 158 are retained against axial shifting on the shaft 153.

It will now be noted that the various disc members of the assemblies 157 and 158 are of substantially the same diameter, and are arranged to variably and independently control the conditions of six different switches 191 and 192 and 193 and 194 and 195 and 196 through the respective actuations thereof by members 201 and 202 and 203 and 204 and 205 and 206 rockably mounted on a spacing bar 154 which is forward of the shaft 153. As shown, the six switches respectively comprise spring contact arms 191' to 196' inclusive mounted on the under side of a common base member 197 of insulating material carried on a spacer bar 154 and normally engageable with a common contact 198 which comprises a flat plate of conducting material mounted at the rear side of the base 197 in upright position and arranged for the engagement of the spring contact arms with its under edge to close the corresponding switches. Opposite the ratchet disc 159, the common contact plate 198 is provided with a downwardly extending L-shaped extension 199 arranged for the engagement of the spring contact arm 191' with the upwardly directed edge thereof.

The present switch-control members 201 to 206 inclusive each comprise bell-crank levers having upright arms providing points for respectively engaging the pins 175 on the ratchet disc 159, the notch 176 of the cylinder 171, the notches of the discs 170 and 169, the notch 183 of the disc 182, and the notches 184 of the disc 180 as the engaged elements are rotated. Generally horizontal arms of the said control members are engageable with the extremities of the different switch arms 191' to 196' inclusive for swinging the latter to open their circuits at the common contact plate 198, and tension springs

207 are constantly operative against the control levers to urge an upward swinging thereof.

By particular reference to Figures 12 and 14 it will be noted that the spring 207 of the member 201 normally retains the switch-engaging arm of the member against a stop pin 208 extending from the plate 152 while the pin-engaging point 201' of the member lies in the path of movement of the shanks of the pins 175 on the disc 159, the switch 191 being held open except when a pin 175 engages the lever point 201'. When the rotary adjustment of the disc 159 engages the shank of a pin 175 with the point 201', the latter is deflected outwardly with respect to the disc axis to rock the member 201 to close the switch 191 at the extension 199 of the member 198 during that setting of the disc. Since the pins 175 may be mounted on the disc 159 in any number and arrangement, the times and frequency of closing of the switch 191 in each rotative cycle of the disc may be varied at will. The sockets 174 may be numbered or otherwise differentiated whereby the pins may be placed therein in any predetermined number and arrangement.

By reference to Figure 16, it will be noted that the switch 192 is arranged to be held open except while the point 202' of the member 202 engages the notch 176 of the cylinder 171, the latter occurring but once in every fifty-two rotary adjustments of the cylinder. The twenty-six notches of the discs 170 and 169 are arranged to receive the points 203' and 204' of the members 203 and 204 respectively at every other setting of the discs and alternately with respect to the discs whereby, as will be evident from a consideration of Figures 14 and 15, the switches 193 and 194 will be alternately closed and open for successive settings of the assembly 157.

Referring to the switch control assembly 158, it will be noted by reference to Figures 12 and 18 and 19 that the point 205' of the member 205 engages the notch 185 of the disc 182 once in every complete rotation of the assembly by the pawl 162 to then permit a closing of the switch 195. Also, the point 206' of the member 206 engages a notch 184 of the disc 180 to close the switch 197 nine times in each rotation of the assembly 158. Since the ratchet disc 160 has two less teeth than the ratchet disc 159, the assembly 158 will be rotated at a faster rate than the assembly 157 as the pawls 161 and 162 are rotated together by the electromagnet 76. It will be understood that the switch 195 is arranged to be closed in lieu of the switch 196 once in each revolution of the assembly 158.

The assemblies 157 and 158 may be frictionally and releasably retained in successive set positions thereof as by the engagement of spring-pressed detent rollers 209' in the notches defined between the teeth of the ratchet discs 159 and 160. As shown, the rollers 209' are carried at the ends of upright arms of bell-crank levers 209 similar to the members 201 to 206 and mounted on the same frame bar 154, springs 210 being operative against the other lever arms to yieldingly urge a retention of the respective rollers in the notches of the discs. It will be noted that the separate driving of the ratchet discs 159 and 160 of the two assemblies permits independent and predetermined initial settings of the assemblies 157 and 158 with reference to the mark 95 to which the code wheels 80 are initially set.

The contact bar 198 for the switches 191 to 196 inclusive is connected to the same battery terminal 100 as the bar 98 by means of a wire 215, and the switch arms 191' to 194' inclusive are respectively connected with plug-receiving sockets 211 and 212 and 213 and 214 which are provided in a front casing member 217 of the control unit 86. As shown, the member 217 is fixed to the forward ends of the side plates 151 and 152, and a plate 218 overlies the top edges of the plates 151 and 152 and extends rearwardly to the disc assembly of the unit 86 to cover the switches and the control levers therefor.

The sockets 211 to 214 are arranged to interchangeably receive single-contact connector plugs 219 carried at the extremities of flexible conductors 221 which extend from a terminal of each of the solenoids 131'' of the four different electromagnets 131; it will be recalled that the armatures of these electromagnets are separately operative when energized for rotatively adjusting the different code wheels 80 by actuating the pawls 139 in the described manner. This interchangeable connection for the electromagnets 131 very much increases the secrecy of coding, it being noted that the connection may be left open for one or more of the electromagnets if desired to further vary the scheme of advancing the code wheels.

By particular reference to Figure 28, it will now be noted that the other terminals of the electromagnets 131 are connected by a common conductor 222 with a fixed contact of a normally open electromagnetic switch 223 which has its other switch contact comprising an armature 223' connected with the terminal 62' of the switch 61 by means of a conductor 225. In the present instance, the armature 223' of the switch 223 is disposed to close the circuit which includes it against the resistance of a spring 224 and only when the arm-controlling solenoid 223'' is energized. One terminal of the electromagnet 76 which controls the switches 191 to 196 in the described manner is connected with the conductor 222 by means of a conductor wire 226, while the other terminal of said solenoid is connected to the battery terminal 101 through the bar 198 by a connecting wire 227. The arrangement is understood to provide mutually parallel circuits for the electromagnets 76 and 131 between the battery terminal 100 and the switch 223, all five circuits being controlled jointly by the electromagnetic switch 223 and the mechanically operated switch 61 which are in series with the other battery terminal 101. Since the switch 61 is also included in the coding circuit, coding and code wheel shifting may only occur as successive operations following the closing of a character circuit by the depression of a character key, and the switch 61 thus constitutes a master switch and may be so referred to.

As is shown in Figures 1 to 4 and 28, the typewriter or printing machine 31 is provided with a key 229 for depression to effect a return movement of the carriage and an advance movement of the print-receiving sheet at the end of a line of typing by means which are well known in the typewriter art. The machine 31 may be a usual one arranged for the solely hand operation of its keys, but I prefer an electric typewriter wherein a slight manual displacement of a key causes the completed actuation of the key by electrical means, reference being made, by way of example, to an electrically operated typewriter known as the "International"; by the use of the latter class of typewriter, the character circuits

of the present cipher apparatus may directly supply enough power to actuate the keys of the typewriter.

Individual electromagnets 231 of similar structure are provided for selectively effecting depressions of the various keys 36' and 37' and 40' and 229 of the typewriter 31 when their circuits are energized. In the present instance, the various keys are carried at the forward ends of similar keybars 230, and movable armatures or cores 232 of the electromagnets 231 are suitably connected with the keybars for depressing them to cause the printing of characters when the solenoids of the electromagnets are energized. As shown in Figures 2 and 3, armatures 232 which normally extend upwardly from the bores of the solenoids for movement into the cores when the solenoids are energized carry hooks 234 which engage over the keybars 230 to normally support the armatures 232 in raised position in their solenoids. An alternative arrangement would be one in which a push rod 234'' depends from an armature 232 which is engaged in a solenoid 233 which is supported above a key to be depressed for printing, this arrangement being indicated in Figure 4. In either event the various solenoids 233 would preferably be provided as a unitary set thereof for fixed mounting on the typewriter 31; in Figure 1, the solenoids 233 are shown as mounted on a common base plate 235 which is in turn secured beneath the typewriter 31.

By reference to Figures 1 and 28, it will be noted that the various control circuit wires to and from the typewriter 31 are grouped and carried together in a common conduit 237 and terminate at a multiple connector head 238 for detachable connection with corresponding terminals 239 of the solenoids 233 by which the various character keys of the unit 31 are controlled. The output wires 111 of the reversing switches 104 are continued through the connector 238 to terminals of different character-printing solenoids 233, the other terminals of the same solenoids are connected by a common return wire 241 to one terminal of the solenoid 233'' of the electromagnetic switch 223, and the other terminal of the latter solenoid is connected to the wire 225.

With the described connections, the closing of the switch 223 to actuate the wheel control unit 86 is arranged to be effected only when the switch 61 has been closed by the depression of a character key at the keyboard of the cipher machine 30 to simultaneously close a character circuit. It will be understood that the mechanical closing of any character circuit through the code wheel assembly 77 and the simultaneous mechanical closing of the switch 61 causes the energizing of a character circuit in accordance with the key which is actuated to operate an appropriate key of the typewriter while the pawls 161 and 162 are being moved to operative positions with respect to the ratchet wheels 159 and 160 respectively of the unit 86 by the action of the energized solenoid 76. Also, a solenoid 131'' connected by a wire 221 with any one of the switch arms 191 to 194 which engages the contact 198 will be energized to similarly shift its pawl 139 with respect to the ratchet of the code wheel 80 which it controls; in the present instance, solenoid circuits are normally closed alternately at the contacts 193 and 194 whereby the solenoids connected with said contacts are alternately energized each time a character circuit is closed.

The carriage return circuit, which has no control key at the cipher machine keyboard in the present instance, includes in order the wire 215, the common contact 198, the switch arm 195', a wire 244 leading through the connector 238 to the solenoid 233—*r* which controls the key 228, and a wire 245 from the other solenoid terminal to the wire 243 to complete the circuit to the battery E. Since the disc 182 is disposed to close the carriage return circuit only after each fifty character impulses have acted to print characters in coding, the arrangement is understood to operate only at the end of each line of printing to dispose the typewriter carriage and the paper thereon for receiving a succeeding line of printing.

Recalling that a typewriter carriage automatically shifts for the space of one character following the printing of a character, and that the notches 185 of the disc 180 are operative after each five character impulses, except when the carriage shift circuit is energized, to temporarily engage the spring contact 196' with the contact 198 to close the spacing circuit thereat, the present device is operative to effect an extra space shift of the typewriter carriage, provided the circuit for the solenoid 233—*s* which is operative to actuate the spacing key 40' is otherwise closed. In this manner, the characters of a coded message may be printed in groups of five in their line, this facilitating decoding since an operator may readily remember a succession of five code characters and keep his place in the copy while he is operating the cipher machine for decoding the typed coded message. It will be understood that the omission of a notch 185 from the disc 180 in the axial line of the notch 184 of the disc 182 provides for the carriage return action in lieu of an extra space shift at this point in the operative cycle of the two discs.

By reference to Figure 28 wherein the reversing switch element 116 is in coding position, it will be noted that a wire 246 extends from the contact 196' to one terminal of a single-pole switch 247, and a wire 248 connects the other terminal of the switch 247 with the spring contact 129 on the frame side 34. The contact 127 on the element 116 which engages the contact 129 during coding is connected by a wire 249 with one terminal of the solenoid 233—*s* which is arranged for energizing to actuate the spacing key 40' of the typewriter 31, and the other terminal of the solenoid 233—*s* is connected by a wire 251 with the wire 243 leading to the battery terminal 101. It will be understood that the arrangement is such that no control of the spacing key 40' is provided at the cipher machine keyboard during coding, and that the described group spacing of the printed characters is provided only when the switch 247 is closed. The switch 247 is shown in Figure 1 as mounted on the top wall 125 of the casing 123 for its ready accessibility to the operator.

It will now be particularly noted that the wire 243 provides a common connection from the solenoids 233—*u* and 233—*s* and 233—*r* directly to the battery terminal 101 whereby the energizing of one or more of these solenoids may follow the de-energizing of the solenoids 233—*c* which control the character keys 36' of the typewriter. This provides for an operative cycle wherein any shift or spacing or carriage return operations are arranged to occur after a character has been printed and the character circuit has been automatically reopened at the switch 61 in the described manner, it being recalled that the code wheels 80 and the switch control assemblies 157

and 158 of the control unit 86 are mechanically actuated by the return movements of the freed and previously advanced pawls 139 and 161 and 162 respectively.

In printing a coded message with the present apparatus, a character is printed whenever a space occurs in the original message, and means are provided for utilizing one of the keyboard characters for the purpose. The character chosen would preferably, though not necessarily, be one which occurs less often in written matter; in the present instance the letter Z has been chosen to represent a space in the original message. Accordingly, and as shown in Figure 28, the contact 97 for the space key 40 is connected by a wire 252 to the wire 103 from the contact 97 for the Z key, and the connection between the reversing switch contacts 106 of the reversing switch 104 which has the wire 103 connected thereto is omitted. A wire 253 connects the wire 108 which leads from the switch contact 106 for engaging the input terminal 105 of the Z switch during coding with the switch arm 130 on the plate 33, and a wire 254 connects the contact 128 on the member 116 with the wire 249 from the contact 127 at the other end of the member.

Having the switch 128—130 open during coding, the letter Z is arrangad to be coded through the code wheel assembly 77 in the same manner as any other keyboard character to cause a printing of the coded character of the letter Z whether the Z key or the spacing key 40 is depressed. If, however, the member 116 is shifted to decode position, the switch 128—130 is closed, the switch 127—129 is opened, the Z input terminal 105 engages a reverse contact 109, and the corresponding output terminal 112 engages the unconnected reversing terminal 106 whereby no connection is provided for the wire 111 from the terminal 112. Under the latter conditions, if a key 36 for a code character which is the code for Z or a space is depressed, a closed circuit is created to include a wire 109, the code wheel assembly 77, the wire 108 which leads to the Z contact 106, the wire 253 to the switch contact 130 which engages the contact 128, the wire 254, and the wire 249 to the solenoid 233—s of the printing machine. In this manner, a space is provided in the decoded and printed message whenever a space or the letter Z occurred in the original message, it being important to note that the present device has coded spaces with the same coding complexity as the characters of the keyboard.

From the foregoing description, taken in connection with the accompanying drawings, the advantages of the cipher mechanism of my invention will be readily understood by those skilled in the art to which the invention appertains. While I have described the principles of operation, together with devices which I now consider to be preferred embodiments thereof, I desire to have it understood that the showing is primarily illustrative, and that such changes may be made, when desired, as fall within the scope of the following claims:

I claim:

1. In a cipher machine, an electric keyboard comprising a plurality of keys, a coding circuit providing in part a set of mutually parallel branch circuits having one branch circuit for each key, normally open switches interposed in the different branch circuits and selectively closable by said keys, a normally open master switch interposed in an unbranched circuit part and closable by any of said keys, a normally open electromagnetic switch having its solenoid interposed in the unbranched circuit part, an electromagnet operative to effect an opening of the master switch, and a secondary circuit including the electromagnet and the switch of the electromagnetic switch whereby the closing of the coding circuit is operative to open the master switch therein after a coding operation is completed.

2. In cryptographic apparatus, a plurality of keys for selective actuation, means providing an electric circuit including in part a set of mutually parallel branch circuits, individual switches interposed in the different branch circuits and closable by said keys, an electromagnetic printing mechanism operative in each branch circuit, a rotatively adjustable code-changing wheel providing closed portions of all of the branch circuits between the switches and printing mechanisms for adjustment to change the connections between the switches and mechanisms, a normally open master switch interposed in an unbranched circuit part and closable by any of said keys, an electromagnet having an armature for displacement in a working stroke to open said master switch and thereafter effect a code-changing adjustment of the code wheel upon its return stroke, and an electromagnetic switch having its solenoid included in the circuit and its switch controlling a branch circuit through the solenoid of the electromagnet whereby to energize said electromagnet when the circuit is closed by the actuation of said key.

3. In a code changing means for a cryptographic machine, a member providing two interconnected like sets of electrical contacts which are aligned and equally spaced in their sets in circles having their centers in a common line, a second member providing two sets of contacts complementary to and normally engaging the contacts of the different sets of the first member, means mounting the members for their relative rotative adjustment about said line, and means operative to effect successive rotative adjustments of one member with respect to the other through half the angular spacing of successive contacts, the contacts of the mutually engaged pairs of contact sets being so related that each actuation of the adjustment means is arranged to change the connections of the contacts of but one said pair of sets.

4. In a code changing means for a cryptographic machine, a member providing two interconnected like sets of electrical contacts which are aligned and equally spaced in their sets in circles having their centers in a common line, a second member providing two sets of brushes complementary to and normally engaging the contacts of the different sets of the first member, means mounting the members for their relative rotative adjustment about said line, and means operative to effect successive rotative adjustments of one member with respect to the other through half the angular spacing of successive contacts, the contacts of the mutually engaged contact and brush sets being so constituted and related that each actuation of the adjustment means is arranged to change the contact and brush connections at one contact set while maintaining the same contact and brush connections at the other contact set.

5. In a code changing means for a cryptographic machine, a member providing two interconnected sets of contacts which are equally spaced in circular lines having their centers in a common line and are of such like lengths in

their respective lines that they extend for no less than half their center-to-center spacing therein, a second member providing two sets of brushes complementary to and normally engaging the contacts of the different sets of the first member, means mounting the members for their relative rotative adjustment about said line, and means operative to effect successive rotative adjustments of one member with respect to the other through half the angular center-to-center spacing of successive contacts, the said contact sets being so related to said brushes that an actuation of the adjustment means is arranged to maintain the engagement of one set of brushes with the same contacts of one contact set while effecting the contact of the other set of brushes with adjacent contacts of the other contact set.

6. In cryptographic apparatus, a plurality of keys for selective actuation, means providing an electric circuit including in part a set of mutually parallel branch circuits, individual switches interposed in the different branch circuits and selectively closable by said keys, an electromagnetic printing mechanism operative in each said branch circuit, a plurality of mutually adjustable code wheels interposed between the switches and the printing mechanism for jointly providing variable closed portions of all of said circuits, individual electromagnets operative when energized to adjust the setting of said code wheels, individual and normally open control switches for the circuits of said electromagnets, a normally open master switch interposed in an unbranched circuit part and closable by any of said keys, a normally open electromagnetic switch having its solenoid interposed in the unbranched circuit part, and an electromagnet controlled by the electromagnetic switch having its solenoid interposed in another branch circuit part and having its armature dipslaceable in a working stroke to open said master switch and thereafter effect a selective closing of one or more of said control switches for the wheel-adjusting electromagnets of the code wheels.

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