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DRAWINGS ATTACHED.

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1,152,707

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COMPLETE SPECIFICATION.

A Ciphering Machine.

We, AB TRANSVERTEX, a Swedish joint-stock company, of Varby, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statment:—

The present invention relates to ciphering machines of the type wherein a clear text is modified by the machine by the addition, during the ciphering operation, of a displacement figure to each of the clear text letters, the same displacement figure being subtracted, during the deciphering operation, from the cipher letter. The cryptographic safety of such machines depends, of course, ultimately on the manner in which such a superimposed series of displacement figures is produced by the machine.

The invention relates more particularly to ciphering machines of the type in which the superimposing series is formed by a number of so-called pin-wheels, the pins of which can be set in active or passive positions to determine the conditions of operation of a selector mechanism adapted to select the displacement figure corresponding to the settings of the pin-wheels in question. In known machines of this type, by utilizing pin-wheels with a large number of divisions and/or a greater number of pin-wheels with a mutually relative prime number in respect to the division, it is easy to produce very lengthy superimposed series without repetition but, so far, no one has succeeded in preventing individual cycles of every pin-wheel from leaving certain indications in the superimposing series, i.e. an active or passive pin on a wheel which returns to operating position after having completed one revolution effects a definite function in the selector mechanism.

[*Price* 4*s.* 6*d.*]

It is an object of the present invention to eliminate this shortcoming by providing that whether the pin on an individual pin-wheel is in active or passive position the selector mechanism is actuated, in dependence on the operative pins of other pin-wheels, in such a manner that if the pin of another pin-wheel changes its operating position from active to passive, or vice versa, the displacement figure formed is not changed by a constant, but in dependence on the operative pins of the other pin-wheels.

According to the present invention, then, we provide a ciphering machine comprising a number of pin-wheels, each provided with a number of pins for actuating a resetting device adapted to produce varying displacement numbers, which can be added to a clear text and subtracted from a cipher text respectively, wherein the resetting device comprises a plurality of recessed combination discs and a plurality of groups of probing devices cooperating therewith, and wherein each pin-wheel actuates a combination disc or group of combination discs in that it sets it or them in one of two positions, whereby only one probing device in each group can be engaged in a recess-combination formed by the recesses of the combination discs and open to the said probing device, the said recess-combination having a predetermined circumferential position for each combination of the relative positions of the pin-wheels, and the combination discs being so formed that if a pin of one of the pin-wheels is moved to its alternative position the new position in which it sets the corresponding combination disc or group of combination discs will afford a recess-combination open to the respective probing devices, the said recess-combination being

displaced from its initial position by a number of steps which depends on the positions of the pins of the other pin-wheels.

An embodiment of the invention is illustrated in the accompanying drawings in which,

Fig. 1 is a plan view of a ciphering machine with its case removed,

Fig. 2 shows the machine in elevation from the left side, the left-hand end wall being removed (section II—II in Fig. 1),

Fig. 3 shows the machine in elevation from the right side, the outer right-hand end wall being removed (section III—III in Fig. 1),

Fig. 4 is a front view of the machine, the key-board and the printing device being removed (section IV—IV in Fig. 1),

Figs. 5 and 6 are detail views of the setting mechanism of the pin-wheels,

Figs. 7—9 are detail views, Fig. 7 showing portions of the selector mechanism for displacement figures of the machine,

Fig. 8 showing the combination discs of the selector mechanism, and

Fig. 9 showing the design of two guide discs comprised in the selector mechanism,

Fig. 10 is a plan of the time schedule of the machine during one machine cycle.

The machine comprises a base plate 1 to which are secured two side walls 2 and 4 and an intermediate wall 3. Between the walls 3 and 4 are two partition walls 5 and 6. On a shaft 7 between the walls 2 and 3 are rotatably mounted seven pin-wheels 8—14 with 26, 27, 29, 31, 35, 37 and 41 divisions respectively and with pins 15 adjustable in two positions for each division. Each of the pin-wheels, besides, is rigidly connected to one of a series of gear wheels 16—22, each of which has the same number of teeth as there are divisions of the pin-wheel with which it is associated.

The gear wheels 16—22 are in constant engagement with gear wheels 23—29 all of which are rotatably mounted on a drive shaft 30 and have the same number of teeth as each other; their teeth are of different pitches, however, so that they will correspond with the pitches of the teeth of the gear wheels 16—22 with which they mesh. Each of the gear wheels 23—29 is rigidly connected to a setting disc 31 having a serrated periphery and provided with holes 32 (Figures 5 and 6) corresponding in number to the teeth of the gear wheels 23—29, the diameter of the holes being larger than that of balls 33.

Associated with each of the setting discs 31 is a pressure plate 34, the plates 34 being fast on the drive shaft 30. The pressure plates each have the same number of holes as the discs 31 on the same circumference but with a diameter somewhat smaller than the balls 33. Compression springs 35 exert pressure on the setting discs 31 to maintain them and their respective gear wheels 23—29 against the pressure plates 34. As all gear wheels 23—29 have the same number of teeth, all setting discs 31 and pressure plates 34 are identical in respect of their design.

Mounted on a shaft 36 (Figure 2) is a series of seven three-armed levers, each lever having one arm anchored by a spring 38 to one of a series of stops 38^1 on the frame and another arm adapted to be engaged by the pins 15, the arms thus being urged in clock-wise direction by action of the springs 38. The arms are thus adapted to assume one or other of two angular positions.

In the absence of actuation by any of the pins 15, the levers are turned by action of the spring 38 to rest against a stop shaft 39. When actuated by the pins 14, the recesses 40 in the ends of the arms 37 assume the position shown in Figure 2 with respect to pins 41, which project axially from a number of duel combination annular discs 42—53 (see also Figures 7 and 8) having internal teeth providing recesses 70.

The annular discs 42—53 are arranged in pairs including the pairs 42—43, 42^1—43^1, 44—45, 46—47, 48—49, 50—51, 52—53, in such a manner that the two discs of each pair are inter-connected, the annular discs being rotatably supported by means of circumferentially spaced shafts 54—54^1 54^{11} in which are grooves to receive the discs. The discs 42—53 are actuated on displacement of arms 37 through the pins 41, it being understood that the arms can be set in one or the other of two positions, according to the pins 15.

Also supported by the grooves in the shafts 54 are two stationary (fixed) guide discs 55, one at each end of the series of twin discs 42—53.

Mounted between the ends walls 2 and 4 and extending through the series of twin discs 42—53 and the guide discs 55 is a rotatable shaft 56, the shaft 56 having fast thereon two discs 57 and 58 between which are supported eight shafts 59 having eight probing devices 60—67 mounted thereon, the probing means being provided with recesses 68 or shouldered portions (non-recesses) 69 adapted for co-operation with the recesses 70 in the discs 42—53.

Each of the probing devices has attached to it a control spring 72—72^1, the springs 72 being so arranged that four of the probing devices 60—63 tend to turn in clockwise direction, these being the four appearing uppermost on the drawing, the remaining four (the lowermost) probing devices 64—67 tending to turn in anti-clockwise direction.

The discs 42—53 are so constructed that, in mutual combination, as shown in Figures

1 and 7 (in which the groups of the 7 combination discs each comprising two discs are arranged according to the scheme 42—43, 43—42, 44—45, 46—47, 48—49, 50—51, 52—53) the discs together with the two guide discs 55 at every imaginable combination of active or passive pins 15 actuating the arms 37, permit of only one possibility for any of the probing devicse 60—63 to be stopped on anti-clockwise rotation of the shaft 56 during one revolution and only one possibility for any of probing devices 64—67 to be stopped on clockwise rotation of the shaft 56 during one revolution.

The recesses 70 in the combination discs, furthermore, are so arranged that, depending on the actuation of the discs 42—53 by the pins 15, thirty-two possible positions can develop on rotation of the shaft 56 in an anti-clockwise direction for stopping any one of the probing devices 60—63, and thirty-two possible positions at the rotation of the shaft 56 in a clockwise direction for any one of the probing devices 64—67.

This means, that at each combination of active or passive pins 15, a position of the combination discs 42—53 develops in which position any of the probing devices 60—63 and 64—67 respectively with its recesses 68 and non-recesses 69 respectively co-operates in such a manner with the recesses 70 of the combination discs 42—53, that the non-recesses 69 of the probing members 60—63 and 64—67 respectively can engage by action of the springs 72 with a row of recesses 70 and thereby prevent the rotation of the shaft 56.

On that portion of the shaft 56 located between the end walls 3 and 4 are mounted a coupling wheel 73 and a drive wheel 74; also mounted rotatably on said shaft portion is a gear wheel combination comprising a coupling wheel 75, a drive wheel 76 and a bevel pinion 77, all three components being rigidly connected with each other. Each of the drive wheels 74 and 76 meshes with pinions 157 and 78 respectively, freely rotatable on a shaft 79 which, in its turn, is rotatably supported by the end walls 3 and 4. On the shaft 79 are also fast a gear wheel 80 and two pinion discs 81.

The pinions 78 and 157 are each provided on one side with friction and thrust discs 82 which by action of a compression spring 83 via two pressure plates 84 are pressed against the adjacent faces of the pinions 78 and 157.

The bevel pinion 77 meshes with another bevel pinion 85 having the same number of teeth and fast on a transverse shaft 86, which is mounted for rotation between the end walls 5 and 6 and is provided at its opposite end with two fixed type-wheels, a clear text type-wheel 88 (see also Figure 3) and a cipher type-wheel 87, wheels 87 and 88 being provided with inversely arranged printing alphabets. On shaft 86 are also mounted two discs 89 and 90 between which is eccentrically carried a shaft 91 having a probing member 92 (Figure 4) pivotally mounted thereon, which probing member is urged by a spring 93 in a clockwise direction. For inking the type-wheels an ink roll 94 is mounted in a cradle 95 which in its turn is pivotally mounted on a shaft 96 and by action of a spring (not shown) maintains the ink roll 94 in contact with the type wheels 87, 88.

Three shafts 97 supported at their ends in the walls 5 and 6 are provided with grooves to receive five internally toothed annular setting discs 98—102, these discs each having a peripheral recess 103 engaged by a projection 104 provided on each of five associated setting arms 105—109 which are slidable lengthwise in guides 110—111.

Displacement of the setting arms 105—109 is effected by key levers 113 which are capable of depression about a common shaft 112 against 112 against the action of springs 114, the key levers 113 being movable in front and rear comb guides 116 and 117, the front guide 116 functioning also as a stop 115. The setting arms 105—109 are provided with recesses of conventional type with which the key levers co-operate, in such a manner, that upon depressing a key lever 113 the setting arms 105—109 are displaced one notch or remain immobile.

Fast on a shaft 118 rotatably mounted at its ends in bearings in the walls 3 and 4 are five segmental elements 119—123 (Figures 1 and 3) having curved perimeters which exert a camming action through rollers on a series of associated lever arms as hereinafter described. The segmental element 119 has a curved surface 119^1 for engagement with rollers 126, 126^1 mounted on the arms 125 of a bell crank lever 124 which pivots on a pin 127 carried by the end wall 4. The other arm, which is the left-hand arm as seen in Figure 3, of bell crank 124 is provided with a toothed segment 128 which meshes with a gear wheel 80 on the shaft 79 mounting the pinion discs 81. On rotation of the shaft 118, as the curve 119 strikes the rollers 125 and 126, they will rock the lever 124 and thus impart a reciprocating motion to it. Likewise upon the rotation of the shaft 118, each of the two curves of the elements 120 and 121 through a similar roller motion actuates printing hammers 129 and 130 respectively which are pivoted on a block secured on the bottom plate 1.

The curve of element 122 co-operates with a roller 133 on a two armed lever 132. The lever 132 pivots on a pin 134 on the wall 3 and at its left-hand end (Fig. 3) has a pin 136 which carries a coupling gear wheel 135

adapted to couple together the coupling wheels 73 and 75.

The curve of element 123 on rotation of shaft 118 actuates a two armed lever 137 mounted to a pivot on a fulcrum pin 138 on the wall 3, in such a manner that the arm 137 (Fig. 3) first is turned in anti-clockwise direction against counter-action of a spring 139 connected at its free end to a spring controlled rocker or feed arm 140, which itself is pivotally attached to the other arm 137^1 of leve 137 and thereby moves the feed arm 140 against a driving gear 141 fast on the drive shaft 30. Upon continued movement of arm 140 it moves the drive wheel 141 one division, and upon completion of its movement locks the drive wheel 141 and thereby the drive shaft 30, in that the feed arm 140 is keyed (i.e. wedged) between the drive wheel 141 and a stop lug 142 on the end wall 3.

The arm 137^1 of bell crank 137 is also connected to one end of a link 143 whose other end is pivotally connected to a ratchet lever 144 pivoted on the wall 3. It is understood that the ratchet 144 which as shown in Fig. 3 engages and locks the drive wheel 141, will be turned in anti-clockwise direction when the curve 123 actuates the arm 137 via the link 143 to turn in anti-clockwise direction, thus releasing it from engagement with the drive wheel 141 to allow the drive wheel 141 to be moved one step by the feed arm 140, and upon the return of the feed arm 140 enters the next tooth in the drive wheel 141 in order again to lock the same.

The machine can be driven in a conventional way, which is not described here in detail.

Drive is imparted to the shaft 118 from a motor 145 through a gear and clutch device 146 which causes it to make one revolution for every machining operation. The clutch 146 is operated to rotate the shaft 118 one revolution on depressing a key lever 113, in that the key levers 113 actuate a rocking cradle comprising two arms 147 (See Fig. 2) and 148 mounted to rock on the shaft 112 and interconnected by a universal bar 149, which bar can be actuated by all of the keybars 113 to rock the cradle 147, 148, 149 in clockwise direction. The arm 147 extends into the clutch housing 146 and when rocked actuates the same to rotate the shaft 118 one revolution upon the depression of a key lever. For setting the pin-wheels in their starting position, the pin-wheels are provided with the necessary number of letters 150 corresponding to the division in question, which letters are visible through a window 151 in the outer casing 152 of the machine.

The casing 152 also includes an arcuate depression 153 provided with slots, through which the setting discs 31 project so that they can be actuated from the outside. The feeding arrangements for a paper-tape 158 whereon the clear text and the cipher are printed, is not shown as it is not of essential importance for illustrating the invention. Nor is the construction of the pin-wheels disclosed in detail, as they may be of conventional type.

In operation of the machine, the first step is for the pins of the pin-wheels to be set in active or passive position, according to a predetermined scheme, and the appropriate key set in the window 151 by means of the setting discs 31, the setting discs 31 being turned in one direction or the other. As the shaft 30 is locked by the ratchet 144 and the drive wheel 141, the pressure plate 34 will remain stationary when, for example, the first setting disc 31 is being turned, but the balls 33 which lie partly engaged, i.e. seated, in the holes in the pressure plate, are unseated thus forcing the setting disc 31 and the gear wheel 23 to move some distance to the left (in Fig. 5) against the action by a spring 35, and upon continued rotation the balls snap into position, i.e. engagement with the next hole in the pressure plate 34 and so on.

The setting of the machine having been completed, the ciphering or deciphering operation can be started. On depressing any key lever 113 the cradle 147, 148, 149 is actuated in the manner described, so that the clutch of the machine is actuated and the motor rotates the shaft 118 through one revolution.

It follows that on depression of a particular key lever 113 the setting arms 105—109 are adjusted to the letter combination indicated by the symbol of that key lever 113, and thereby also adjust the setting discs 98—102.

The said setting discs are provided in a known manner with internal teeth providing recesses 155 (Figure 4) arranged in such a manner that upon the depression of a key lever 113 only a single axially coinciding opening of the recesses appears (is exposed), which opening allows a projection 156 on the probe member 92 to fall down (engage therewith) by action of the spring 93 and be stopped from rotation in an anti-clockwise direction (Figure 4) by the shaft 86. The position then occupied by the shaft 86 corresponds to the printing position for the type corresponding to the key lever 113 and being in printing position on the clear text wheel 88. On the operation of the clutch 146 the shaft 118 starts to rotate so that when the curve of element 119 engages the rolls 125 and 126 the lever arm 124 will be caused to rock about the pin 127. When this occurs the gear wheel 80 will revolve in anti-clockwise direction (Figure 3) to drive

the shaft 79 in anti-clockwise direction. By friction of the friction couplings 81, 82, 84, the pinions 78 and 157 are hereby taken along to rotate in clockwise direction and the pinion 78 imparts rotation to the drive wheel 76 and thence to the bevel wheel 77 which is in fast with it. This bevel pinion 77 meshes with the bevel gear 85 which thereby rotates the shaft 86 in anti-clockwise direction (Figure 4). The probe member 92 mounted between the two discs 89 and 90 follows and moves under action of the spring 93 the projection thereon is forced into engagement with the axially coinciding opening 155 which corresponds to the depressed key lever 113. Hereby the probing member 92, and thus, the shaft 86 as well as the bevel gears 85, 77, the drive wheel 76 and the pinion 77 are stopped.

Upon continued rotation of the lever arm 124 in clockwise direction (Figure 3) the friction in the friction coupling 81, 82, 78 is overcome, and the coupling slips until the arm 124 has ceased its rotational movement. The extent of rotation of the arm 124 is so adjusted that it can effect a complete rotation of the shaft 79 and thereby cause the shaft 86 to rotate more than one revolution. The clear text letter is now set in printing position on the clear text typewheel 88.

At the same time as the shaft 86 is rotated, the shaft 56 is also rotated in clockwise direction (Figure 3) via the friction coupling 81, 82, 157 when the shaft 79 is rotated in anti-clockwise direction (Figure 3) by the lever arm 124. The discs 57 and 58 mounted on the shaft 56 are thus rotated and rock the probing members 60—67 in an anti-clockwise direction (Figure 2). As appears from Figure 2, the probing members 60—63 are urged in the anti-clockwise direction of motion, in such a manner that when the position of the recesses, depending on actuation by the pin-wheels 8—14 via the arms 37, allows any of the probing members 60—63 to fall into any open recess combination by action of the associated spring 72, the shaft 56 will be stopped in this position and, as at the setting of the clear text letter, the friction coupling 81, 82, 157 will be overcome and slip during the continued rotation of the shaft 79. Hereby, the starting position of the displacement figure is determined.

After the setting of the clear text letter and of the starting position for the displacement figure, the curves 120, 122 and 123 become operative. The curve 120 which actuates the lever arm 130 and the printing hammer 129 will cause the latter to strike against a paper strip 158 (Figure 1) and prints the clear text letter in question from the clear text type wheel 88 on said strip.

The curve 123 actuates the feed mechanism for the pin wheels 8—14 in a similar manner to advance the wheels by one step. The curve 122 finally actuates the coupling arm 132 so that said arm rocks in a clockwise direction (Figure 3) to move the coupling gear wheel 135 into engagement with the coupling wheels 73 and 75, so that they move in unison.

The combination discs 42—53 will now have assumed new positions, depending on the new position of the pin-wheels 8—14 subsequent to the feed. Thereafter the curve 119 which actuates the arm 124 will cause it to reciprocate by the action of the two rollers 126, 126^1 with the result that the shaft 56 is rotated in clockwise direction via the two friction couplings 81, 82, 78 and 81, 82 and 157, the probing members 64—67 pivoting against the clockwise direction tend to fall into an open recess combination, and when some of the probing members 64—67 have engaged under action of their springs 72, the shaft 56 is stopped in this position. The couplings 81, 82, 78, and 81, 82 and 157 will now slip until the arm 124 has returned to its starting position (Figure 3).

The angle through which the shaft 56 rotates from the starting position determined for the displacement figure during the first phase of the machine cycle corresponds just to the actual displacement figure produced by the machine. This angular motion was also transferred by the rotation of the shaft 56 via the bevel gear 77, 85 to the type wheel pair 87, 88 which thereby rotates the corresponding number of character steps from the position of the clear text letter to the printing position for the cipher type wheel 87. Upon arrival in this position, the curve 121 becomes operative and prints the cipher letters on the paper strip 158 via the arm 129 and printing hammer 130.

Immediately after the probing of the displacement figure, a second feed of the pin-wheels 8—14 is effected. The new position of the said pin-wheels is utilized in the next machine cycle for finding the starting position of the next displacement figure. Immediately before the end of the machine cycle, the coupling between the coupling wheels 73 and 75 is released in that the curve 122 actuates the arm 132 to rotate in an anti-clockwise direction (Figure 3). After the rotation of the shaft 118 by one revolution the coupling 135—136 is released and stops, to become again operative when a key lever 113 is being depressed.

To illustrate the different motion steps in a machine cycle, i.e. when the shaft 118 is being rotated one revolution, reference is made to Figure 10 which shows the motion scheme of the machine during a rotation of the shaft 118 through 360°.

As already mentioned, the embodiment

of the invention illustrated provides thirty-two positions for stopping the shaft 56 in every direction of rotation with the said combination discs 42—53 and seven pin-wheels.

It is, however, possible to obtain other numbers of stop positions and, thereby, other numbers of possible displacement figures, if the number and construction of the combination discs is chosen in a suitable manner. The reason why, in the embodiment of the invention illustrated, the combination discs were chosen with respect to their number and construction to provide thirty-two displacement figures, is that the machine for reason of better clarity should be relatively simple in the design and number of the combination discs.

However, the design and number of the combination discs, as also the number of pin-wheels, may be varied within wide limits.

WHAT WE CLAIM IS:—

1. A ciphering machine comprising a number of pin-wheels, each provided with a number of pins for actuating a resetting device adapted to produce varying displacement numbers, which can be added to a clear text and subtracted from a cipher text respectively, wherein the resetting device comprises a plurality of recessed combination discs and a plurality of groups of probing devices cooperating therewith, and wherein each pin-wheel actuates a combination disc or group of combination discs in that it sets it or them in one of two positions, whereby only one probing device in each group can be engaged in a recess-combination formed by the recesses of the combination discs and open to the said probing device, the said recess-combination having a predetermined circumferential position for each combination of the relative positions of the pin-wheels, and the combination discs being so formed that if a pin of one of the pin-wheels is moved to its alternative position the new position in which it sets the corresponding combination disc or group of combination discs will afford a recess-combination open to the respective probing devices, the said recess-combination being displaced from its initial position by a number of steps which depends on the positions of the pins of the other pin-wheels.

2. A ciphering machine according to claim 1, in which the displacement numbers produced by the machine for every ciphering operation are equal to the number of steps between two consecutive displacement positions, obtained through two consecutive pin-wheel positions.

3. A ciphering machine substantially as described with reference to the accompanying drawings.

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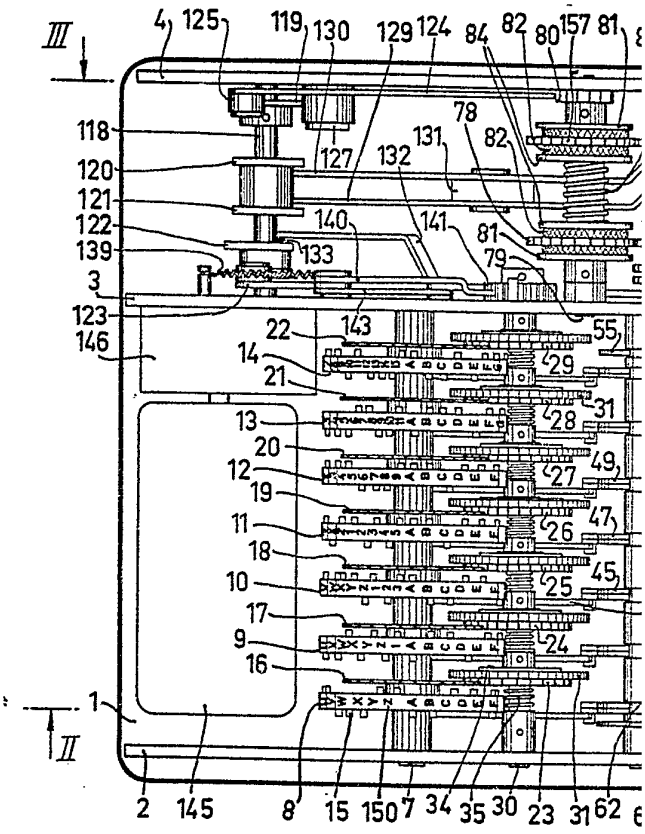
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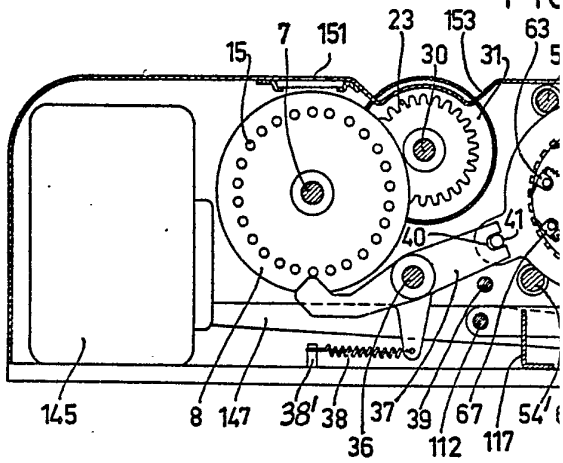
FIG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1152707 COMPLETE SPECIFICATION
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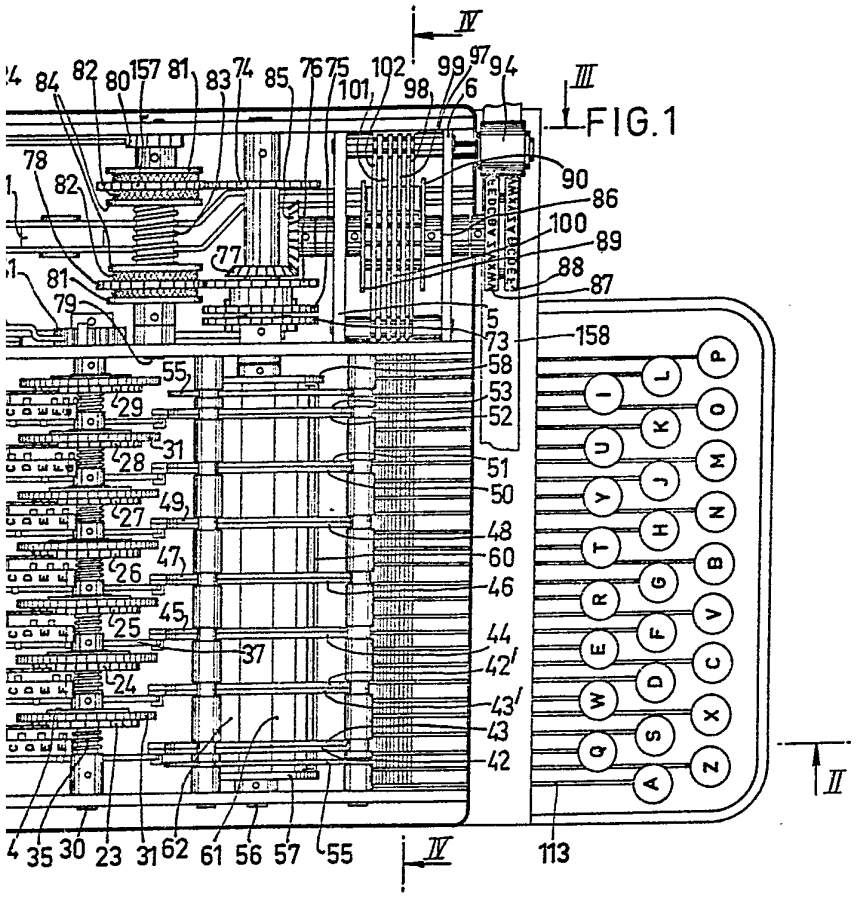
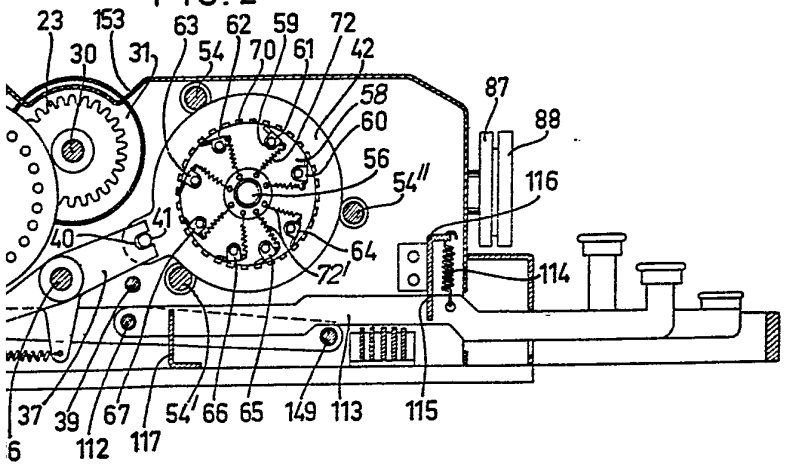


FIG. 2



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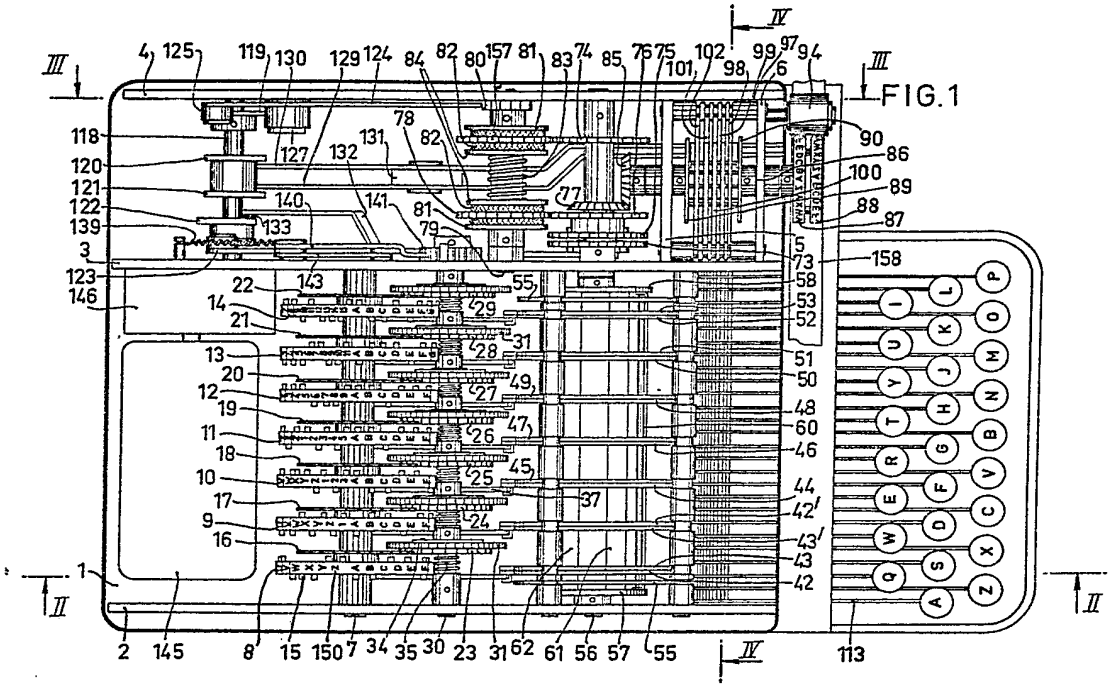

FIG. 1

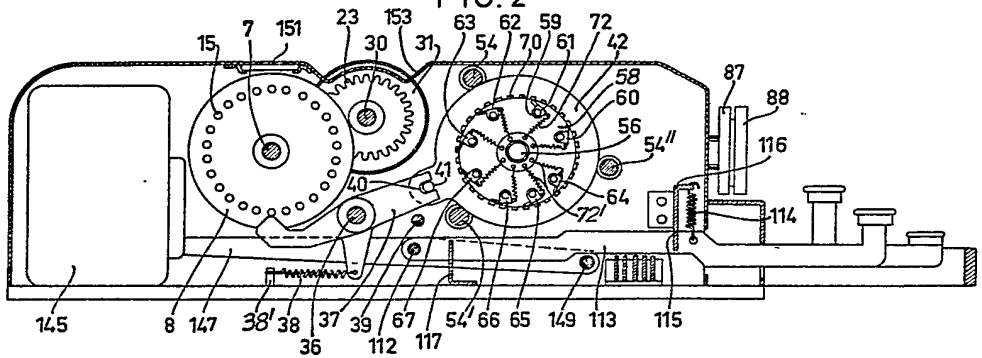

FIG. 2

FIG.3

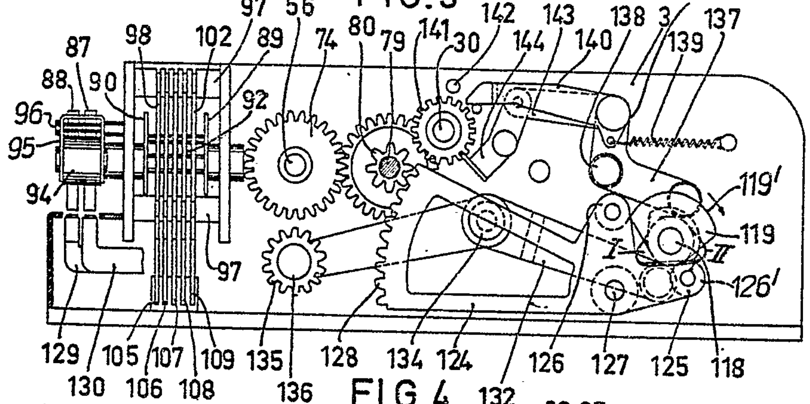
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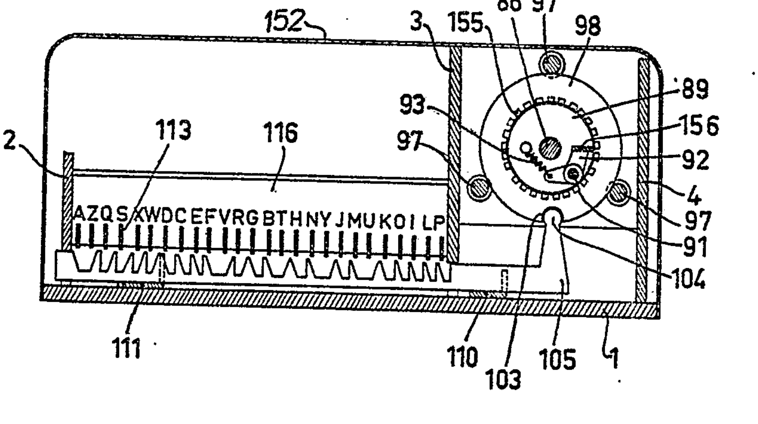
FIG.4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1152707 COMPLETE SPECIFICATION
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Sheets 2 & 3

FIG.6

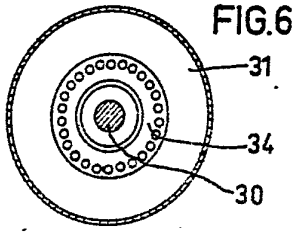
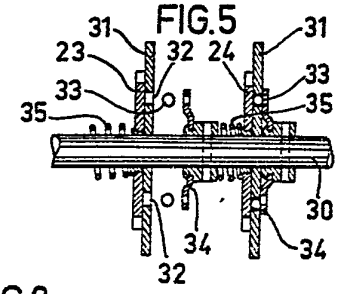
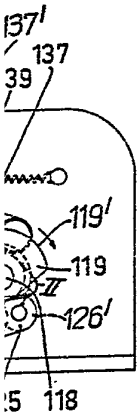


FIG.5





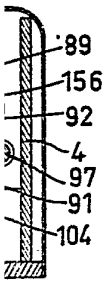


FIG.9

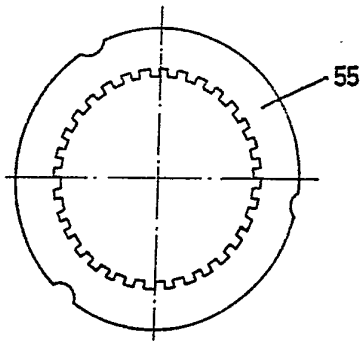
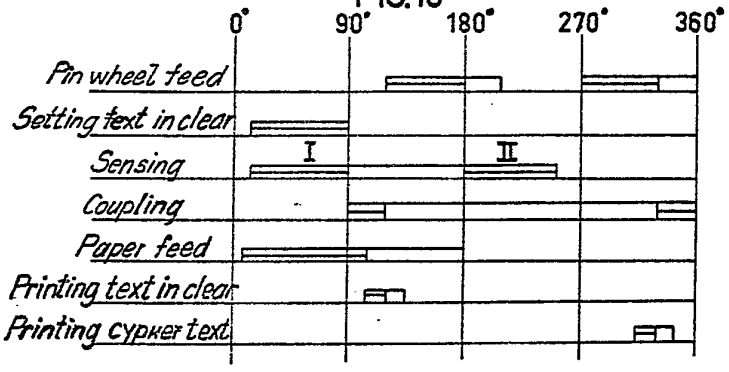


FIG.10



=Active cam operation
=Passive cam operation (Return)

1152707 COMPLETE SPECIFICATION
5 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 2 & 3

FIG.3

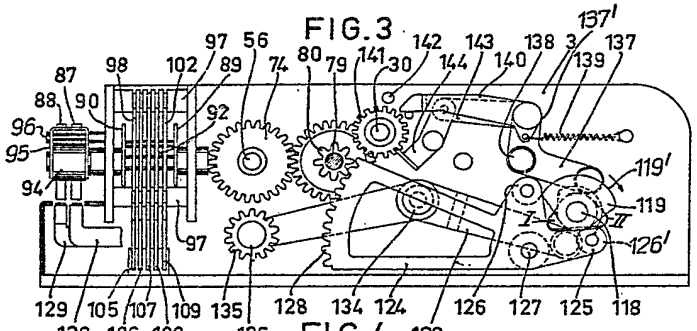


FIG.4

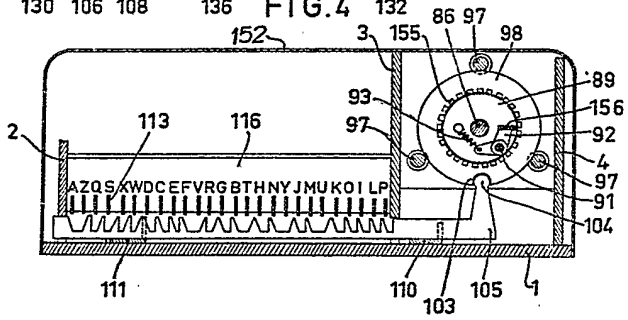


FIG.6

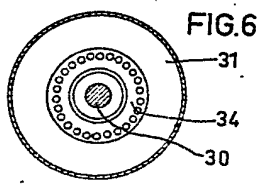


FIG.5

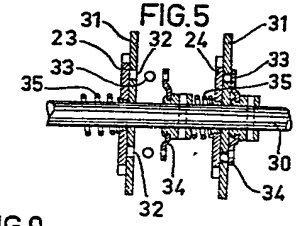


FIG.9

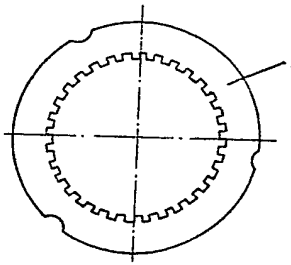
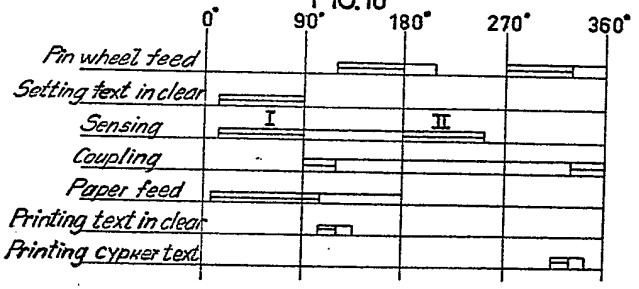
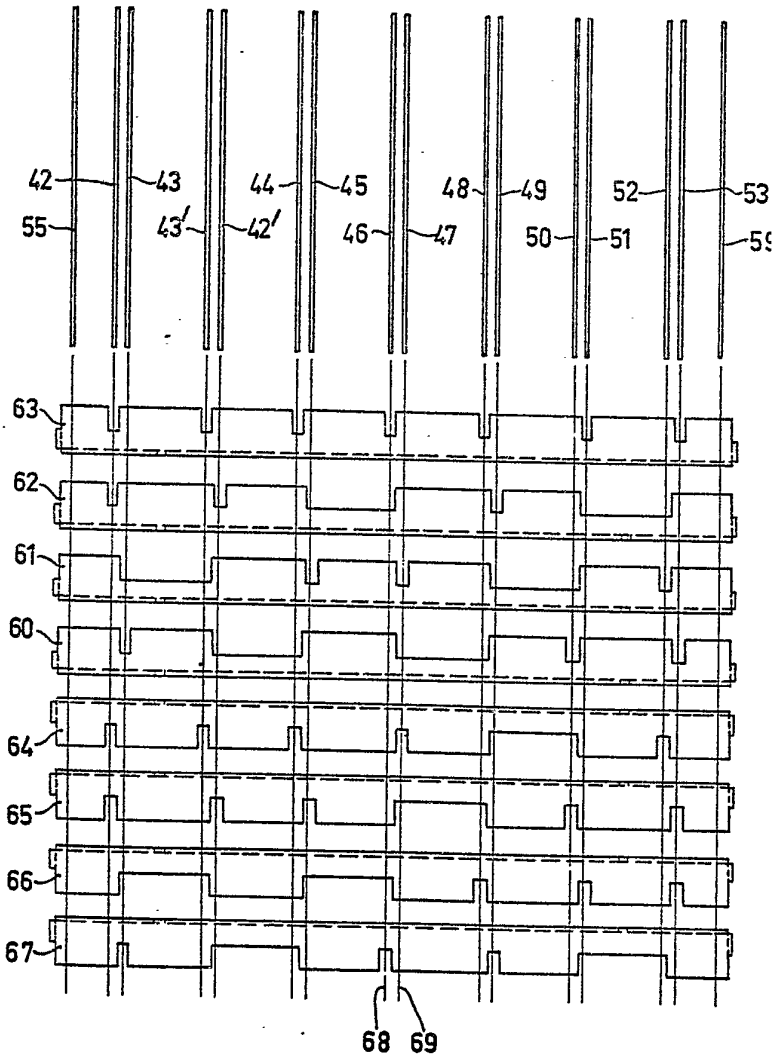


FIG.10



= Active cam operation
= Passive cam operation (Return)

FIG.7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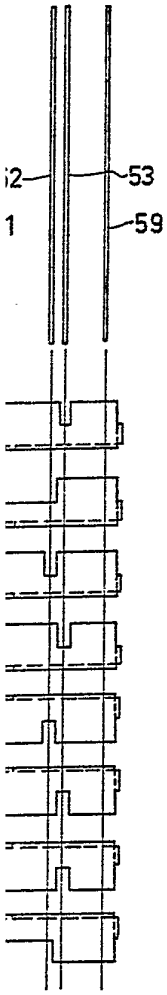
1152707 COMPLETE SPECIFICATION

5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 4 & 5



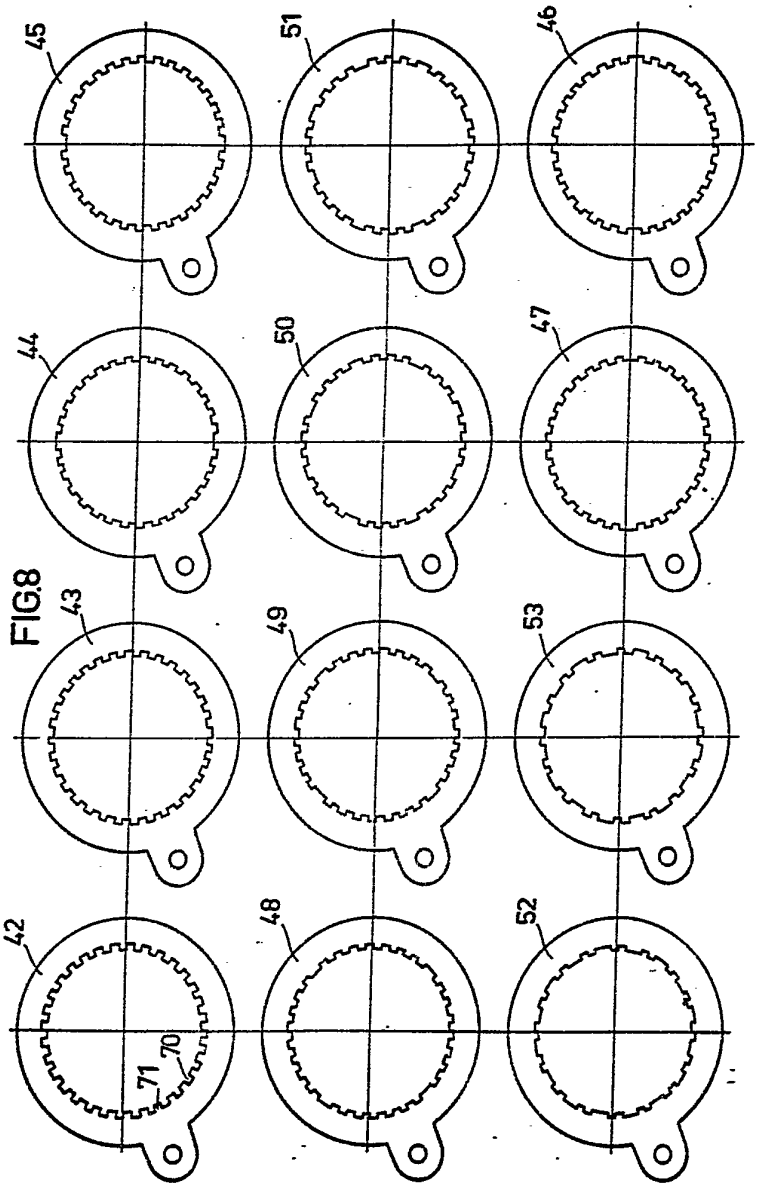


FIG.8

1152707 COMPLETE SPECIFICATION
5 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 4 & 5

FIG.7

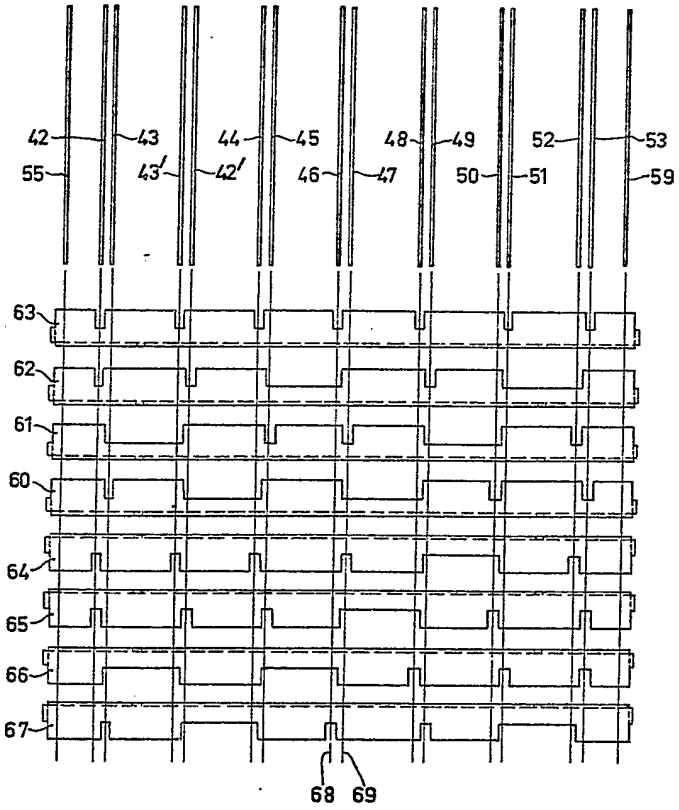


FIG.8