

PATENT SPECIFICATION



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COMPLETE SPECIFICATION.

Ciphering Device.

I, EDWARD CHARLES ROBERT MARKS, a British subject, of 57 & 58, Lincoln's Inn Fields, London, W.C. 2, do hereby declare the nature of this invention (a communication to me from abroad by N. V. Ingenieursbureau "Securitas", of No. 656, Prinzengracht, Amsterdam, Holland, a corporation organised under the laws of Holland), and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to devices which are designed for ciphering a clear text and for deciphering the ciphered text. Such devices consist usually of keys and indicating points in the same number as signs are to be ciphered and of a similar number of interchangeable connecting elements between each key and indicating point. For deciphering, the connecting elements are reversed in such a manner that the ends situated for the ciphering at the side of the clear text are connected with the ciphering side and inversely. Further provisions are made that the interchanging of the connecting elements starting from the same point takes place in exactly the same succession and at the same intervals as at the ciphering.

According to the invention a ciphering device of this type has on the side where the ciphered signs appear a smaller number of indicating points, one for each cipher character, than there are different character signs in the clear text. In order to render this reduction of the number of indicating points possible the signs of the clear text are subdivided into several rows and the keys for each sign of each row are connected by the same connecting element with the same indicating point so that this same indicating point is excited indifferently in which row the sign to be ciphered stands. In order to enable it to be determined, when ciphering, to which row in the ciphered text a particular ciphered sign belongs, separate reversing or shift keys are provided which are connected to indicating points in the

same manner as the keys for the cipher signs and these signs of the reversing or shift keys are ciphered with the rest of the message.

Means are provided, whereby during deciphering when a sign is depressed which belongs to one of the shift keys, a signal is given or a mechanism is released which gives warning of a transfer from one row to another. Ciphering signs for instance half of the small letters of the alphabet will be preferably used and, in order to have signs available for the reversing keys further letters in number of the latter will have to be added, such letters not being used at all in the alphabet as for instance ä ö ü. These letters, together with one half of the small letters form the first row of signs which alone are used to give the ciphered text. These letters may be arranged as the uppermost row of a number of rows of a type wheel. The next row of the type wheel is formed by the other half of the small letters and the third row by the figures, stops, and similar signs as may more clearly be seen from the drawings. The number of reversing keys can be selected at will, for instance only one reversing key could be used if only two rows of signs are in the clear text so that each time only the transition from one row of signs to the other is marked. This presents however the inconvenience that, for instance if one part of the text has been destroyed, it can no longer be discerned to which of the two rows it has to be reversed so that it is better to arrange as many reversing keys as there are rows of signs so that it is clearly indicated to which row belong the signs following upon the reversing sign. As the reversing signs are connected with the indicating points by means of the interchangeable connecting elements in the same manner as all the other signs they are also ciphered and no longer recognisable in the ciphered text as reversing signs.

Two forms of execution of the invention are shown by way of example on the accompanying drawing, wherein:

Figs. 1 and 2 illustrate diagrammatically the idea of the invention with the aid of a simple example.

Fig. 3 shows a ciphering device which, similar to a typewriting machine, comprises a row of keys and a typewriting device and which is worked like a typewriting machine.

A further advantage of the invention is that it facilitates essentially the correspondence by cable as those signs which are the longest in the Morse alphabet, for instance the long signs for the numerals are not required at all in the ciphered text.

In Figs. 1 and 2 a ciphering device is diagrammatically shown which comprises two rows each of nine clear text signs and of one reversing sign. Fig. 1 shows the ciphering connection and Fig. 2 shows the deciphering connection. 11 are the contact keys marked with the letters *a* to *i* and with the figures 1 to 9. 12 are incandescent electric lamps marked with the same letters *a* to *i* and the figures 1 to 9. Directly behind the contacts 11 incandescent lamps 13 are inserted which are marked with the sign of the corresponding contact keys. The reversing key 14 is marked with the letter *j* and mounted in series with an incandescent lamp 15 which is coloured red to distinguish the same from the other lamps. A lamp in the row 12 corresponding with the contact key *j* is also marked with the letter *j*. At the side of this lamp a red lamp 19 is arranged in such a manner that by a switch 20 the lamps *j* and 19 can be interchanged. Between the lamps 12 and the contacts 11 contact rows 16 and 17 are arranged which are connected with one another in irregular manner so that each of the contacts 16 is connected with one of the contacts 17. The connection between the rows of contacts is indicated by lines. The connected contacts of the two rows are marked with the same figures. The manner of connection between the contacts 16 and 17 forms the ciphering key.

As one pole of the contact keys 11 and one pole of the incandescent lamps 12 are under voltage the corresponding lamp of row 13 and one of the lamps of row 12 will light up at the depression of one of the keys 11. For explaining the connection the proceeding when ciphering the signs *a b c d 1 2 3 4 e f g* will be hereafter described. In order to cipher this succession of signs the keys of row 11 are successively depressed whereby in row 12 the incandescent lamps *e c j b* will light up successively. As a figure follows upon *d* the key *j* is depressed so that in row 12 the lamp marked *f* will light up. The figures 1, 2, 3 and 4 light up the letters *e*,

c, *j* and *b*. As after 4 another reversal is necessary the key *j* is depressed again so that in row 12 the letter *f* will light up. The letters *e*, *f*, *g* produce the letters *h*, *a*, *d*.

The clear text *a b c d, 1 2 3 4, e f g* is therefore transformed into the following ciphered text *e c j b f c c j b f h a d*. Simultaneously with the incandescent lamps of row 12 the incandescent lamps of row 13 are illuminated to enable control of the apparatus.

To decipher, the connection of the contact rows 16 and 17 have to be altered accordingly in such a manner that both contact rows are mounted with their connections for instance upon one board which can be revolved for 180° around an axle situated in the plane of the figure so that the contact row which formed previously the row 17 forms now the row 16 and inversely. The connection which has thus been produced is shown in Fig. 2.

For deciphering, the switch 20 has further been reversed upon the red lamp 19, it having been previously connected with the lamp marked *j* of the row 12. If now the letters *e c j b* of the ciphered text are depressed the letters *a b c d* will successively appear in the row 12 of incandescent lamps. If the contact key *f* is depressed the red lamp 19 will light up and indicate that the following signs are figures. If the letters *e c j b* are depressed the incandescent lamps 1 2 3 4 will light up successively. At the depression of the contact key 11 (cypher *f*) the reversing incandescent lamp 19 will light up again indicating the transition to the letters. At the depressing of the contact keys *h a d* the incandescent lamps *e f g* will light up. The ciphering has thus been translated into the clear text.

The form of construction shown in Fig. 3 shows a ciphering apparatus with three rows of signs in clear text and corresponding with these three rows of signs three reversing keys. 21 are the keys of which six are marked each with three signs of the clear text, the last three being marked with the reversing signs *e a o*. The shafts 22 of the keys are guided in borings of a U-shaped support 23. These shafts rest upon the upper contact springs of contact keys 24. 26 is a feeding cylinder of insulating material upon which nine pairs of electricity conducting sectors 27 are fixed, each pair being situated the one opposite the other and for every 2 sectors four contact springs 68, 69, 70, 71 are provided which are displaced the one with regard to the others of approximately 90°. Upon the shaft 28 of the feeding cylinder a lever 29 is fixed adapted to be moved between the abutments 30 and 31.

The feeding cylinder can therefore be revolved 90°. 32, 33, 34 is a device designed to interchange the electric connections between the keys and indicating points. It consists of cylinders of insulating material mounted upon an axle 35. The cylinders 33 have upon each face 9 contacts arranged in a circle. These contacts are connected the one with the other in such a manner that always one contact of the one side is connected with one contact of the other side as confusedly as possible. The cylinders have on their peripheries toothed crowns by means of which they can be revolved around the axle 35. The cylinder 34 is constructed similar to the cylinders 33 but with the difference that the opposite contacts on the two end faces are connected the one with the other and that the said cylinder is not revoluble but movable upon the axle 35. With the aid of a lever 36 and of a spring 37 cylinder 34 presses the cylinders 33 against the left hand side stationary cylinder 32. The cylinder 34 can however be pressed by hand in opposition to the pressure of the spring against the right hand side cylinder 32. 38 are three toothed wheels in gear with the toothed crowns upon the cylinders 33. The toothed wheels 38 are keyed upon the shaft 39 and their teeth are arranged as irregularly as possible so that by a revolution of shaft 39 the several cylinders 33 are revolved through different angles. Upon shaft 39 a key-changing wheel 40 is arranged either directly or through the intermediary of a driving gear 39^a, a pawl 41 engaging with the teeth of said wheel 40 and being pivotally fixed upon an armature 42. The armature 42 is pulled by a spring 43 against the stop 44. The armature can be raised by a relay 45 so that the pawl comes in engagement with the next following tooth. 46 is a platen of a typewriting device. This platen is oscillably mounted in two levers 47 pivotable around the fulcrum 48. The fulcrum 48 is not stationary but mounted in the arm of a lever 49 having a stationary fulcrum 50 and provided with three notches. This lever 49 has at its other arm 3 large teeth 51 of soft iron opposite to which three electromagnets 52, 53, 54 are arranged. 55 is a blade spring which has a nose 56 adapted to engage with one of the three notches of the lever so that this lever can be retained in one of these three positions. 57 is a solenoid the movable core 58 of which is connected through the intermediary of a rocker arm 59 with the lever 47 of the platen. 60 is the typing cylinder which carries upon its circumference three rows of signs the upper row corresponding with the signs marked

at the top upon the keys, the middle row and the lower row corresponding with the middle and lower signs marked upon the keys. The typewriting cylinder is keyed upon shaft 61, said shaft being revolved at uniform speed from a motor which is not shown on the drawing. Upon this shaft 61 a tube 62 of electricity conducting material is fixed so that it is insulated, a brush collector 63 being fixed at one end of said tube and a brush 64 sliding upon its other end. The brush collector 63 slides upon the inner surfaces of a collector composed of nine sectors 65. These sectors are insulated against one another and are held together by an insulating ring 66. 67 is a feed cylinder with three sectors 72 extending approximately over half of the circumference of the cylinder and with three rows of brush collectors 73, 74 and 75 displaced the one with regard to the other of 120°.

The several parts of the machine are connected by leads in the following manner: The upper springs of the contacts 24 are connected with one pole of a source of current 25. The lower contacts are connected with the nine brush collectors 68 arranged in one row of the feeding cylinder 26. The brush collectors 69 of this feeding cylinder arranged in one row are connected with the nine contacts of the interchanging cylinder 32 situated at the left hand end. The brush collectors 70 are connected with the nine sectors 65 of the collector and, as far as they belong to the keys marked with three signs, with the contact pins of the right hand side interchanging cylinder 32. Of the brush collectors 71 arranged in one row the six situated at the front and inserted in the circuit of the keys 21 marked with three signs are connected each with two opposite contact pins of cylinder 34. The three brush collectors which are situated at the back and across which the circuit of the reversing keys goes are connected with the brush collectors 75 of the feeding cylinder 67.

The brushes 74 are connected with the three pairs of contacts of cylinder 34 which are still available and the brushes 73 are connected with the magnet coils 52, 53 and 54. The other three terminals of these magnet coils are connected with the lead 72^a to which also the brush collector 64 is connected across the magnet coil 57. The lead 72^a is guided across the coils of the relay 45 to the other pole of the source of current 25. The relay 45 can be short-circuited by means of a switch 76.

The operation of the apparatus is as follows:—

At the ciphering the lever 29 of the

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reversing cylinder 26, the movable cylinder 34, the feeding cylinder 67 and the switch 76 are in the positions shown. If now for instance the key marked with *a g l* is depressed the current from the source of current 25 flows across the contact 24, the brush collector 68 which is situated the farthest at the front and the hidden sector 27 to the most advanced brush collector 71. From there the current flows to the movable reversing cylinder 34 and then through the three revoluble cylinders 33 to the cylinder 32 and from there to the most advanced brush collector 69 across the visible sector 27 to the contact brush 70 and thence to one of the sectors 65 of the collector. If now the brush 63 fixed upon the continuously rotating shaft 61 comes in contact with this sector under tension the circuit is closed. The current continues to flow across the contact brush 64, the solenoid 57, the relay coils 45, back to the source of current 25. The core 58 of the solenoid is thus pulled into the coil 57 and the paper cylinder 46 is struck against the platen 60, the letter of the platen which corresponds to the determined sector being thus typed. At the same time the armature 42 is raised by the relay 45 so that the pawl 41 engages with the next following tooth of the feed wheel 40. If now the depressed key is released, the coil 45 of the relay becomes also currentless so that the armature 42 is pressed by spring 43 against the stop 44 and shaft 39, toothed wheels 38 and the interchanging cylinders 33 are revolved. Owing to the different arrangement of the teeth upon the toothed wheels 38 the interchanging cylinders 33 execute movements of different amplitudes which must however be calculated so that the contacts of the adjacent cylinders stand always exactly opposite one another. After each letter a new interchanging alphabet is therefore adjusted. When ciphering, no platen shift is made since only one row of signs is employed.

The course of the current remains the same if a reversing key is being depressed. Merely the way of the current between the brushes 71 and the interchanging cylinder 34 varies in so far as the current must first flow across the feed cylinder 67. The current flows through all these several devices in exactly the same manner as if a key marked with three clear text signs is being depressed. The reversing sign is thus also ciphered. In order to decipher with this apparatus the lever 29 has to be reversed so that it comes in contact with the stop 31 and the feed cylinder 67 is brought into such a position that the

rows of brushes 73 and 74 are in connection. The interchanging cylinder 33 must be brought to their initial positions which they occupied when the production of the ciphered text had begun. If now for instance the letter *a* from the ciphered text is depressed which might have been typed in consequence of the depression of the reversing key *a* the current from the source of current 25 has the following course: Across the contact 24 situated in front, the brush 68 situated in front, to the brush 69 situated in front, and from there to the left hand side stationary cylinder 32, through the interchanging cylinders 33 and the movable cylinder 34 to the middle brush 74 of the feed cylinder 67 and from the middle brush 73 across the magnet coil 53 and relay 45 back to the source of current. Consequently the magnet 53 attracts the middle tooth 51 of lever 49 which stands partly opposite said magnet whereby the paper cylinder 26 is lowered so far that the nose 56 engages with the middle notch so that at the next following letters the signs are typed on the platen 46 which stand in the middle row of the typing cylinder. If letters are depressed in the ciphered text which correspond not to reversing signs but to signs of the clear text the operation is exactly as at the ciphering with the only difference that the interchanging cylinders 33 are traversed in opposite direction by the current flowing from the keys to the typing device. The letters of the ciphered text however which have been produced by the depression of the reversing signs at the typing of the clear text cause each time a corresponding adjustment of the paper cylinder.

It is not always necessary to cipher the entire text. The apparatus described permits the insertion of clear text between the ciphered text. With this object in view the cylinder 34 is pressed at the ciphering, by a pressure exerted upon the free end of lever 36, against the right hand side cylinder 32 so that the current flows no longer across the interchanging cylinders 33 but directly across the cylinders 34 and 32 to the point where the typing is to be effected. The reversing cylinder 67 must further be brought into exactly the same position as at the deciphering. The brush rows 73 must therefore be connected with the brush rows 74 so that the magnets 52 and 54 are excited and the platen can be raised or lowered correspondingly. The switch 76 must be closed during the typing of the clear text so that the interchanging cylinders 33 are not further adjusted but that with the new sign to be ciphered after the clear text is finished

the typing is begun at the position of the interchanging cylinders for which they have been adjusted at the typing of the last cipher sign before the beginning of the clear text. The clear text inserted in the ciphered text can be evidently also typed at the deciphering. With this object in view the apparatus must be brought into exactly the same position as at the typing of a clear text inserted between the ciphered text.

The clear text is rendered recognisable in the ciphered message by the interposing of spaces so that there can be no confusion between clear text signs and ciphered signs.

By the object of the invention it has become possible to reduce very much the number of the signs used in the ciphered text, wherefrom results the advantage that the unauthorized deciphering of the ciphered text is rendered very difficult. Only eighteen different letters of the alphabet and numerals appear in the whole of the ciphered text, fifteen for the words of the message and three additional characters which enable the shift characters to be ciphered also. As each of the signs in the ciphered text may represent either a letter of the alphabet, a numeral, a punctuation or other mark, or a shift sign, it is more difficult for an unauthorised person to decipher the message than when each cipher sign corresponds to a single clear text character. In the latter case, as is well known, owing to the frequency with which certain letters of the alphabet recur (the letter *e* being the most frequent) it is easy to detect a certain regular occurrence of these characters in the cipher text by means of which it is possible to decipher it without the key.

This regular recurrence is entirely deranged in the case of the present invention because the same letters of the alphabet are repeated far oftener but have a different meaning each time, which will mislead any unauthorised person attempting to decipher the text. The deciphering with the aid of the machine is however facilitated considerably as at the deciphering only one row of signs need be depressed.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. Ciphering device with interchange-

able connecting elements between the keys and the indication points characterized in that the number of the indication points, one for each cipher character is less than the number of different characters in the clear text.

2. Ciphering device as claimed in Claim 1 with several rows of signs for the clear text characterized in that as many indication points are provided for the ciphered text as the longest row of signs of the clear text comprises signs.

3. Ciphering device as claimed in Claims 1 and 2 characterized in that for several sign rows for the clear text a reversing sign for the transition from one row of signs to the other is provided whereby this reversing sign appears ciphered upon the indicating side.

4. Ciphering device as claimed in Claims 1 to 3 characterized in that for each row of signs a separate reversing sign is provided.

5. Ciphering device as claimed in Claims 1 to 4 characterized in that for deciphering sign transmitters (19) or devices (51—54) are arranged in order to reverse the indicating device for the clear text upon the several rows of signs.

6. Ciphering device as claimed in Claims 1 to 4 characterized in that upon the indicating side of the interchangeable connecting elements (32—34) several connections corresponding to the reversing signs are conducted to a separate reverser (67 and 72 to 75) which permits of a selective connection of these leads at the ciphering with the indicating points or at the deciphering with a reversing device (51—54).

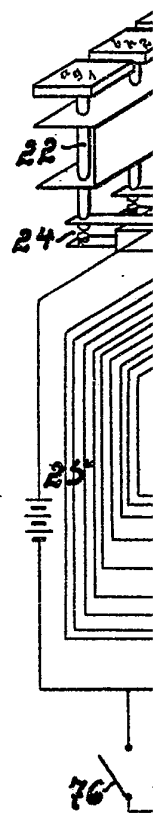
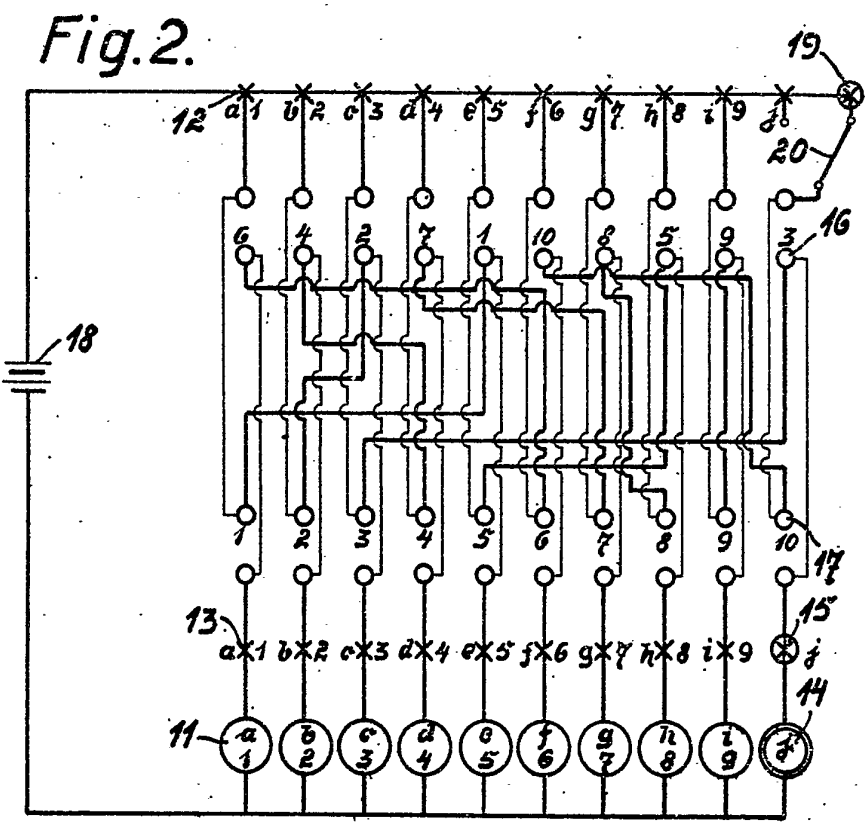
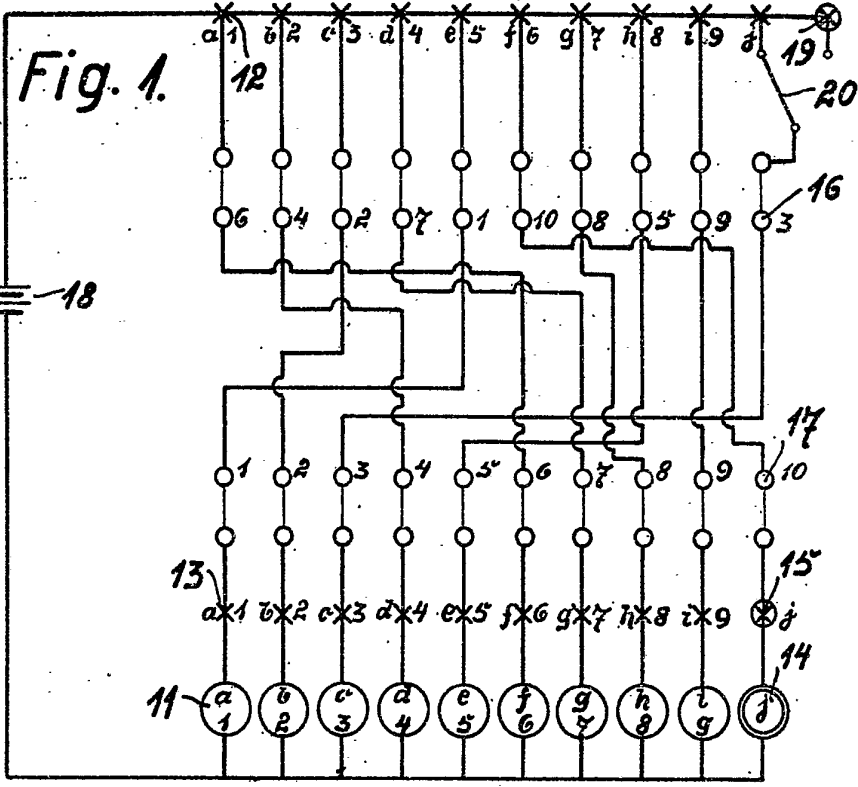
7. Ciphering device as claimed in Claims 1 to 6 characterized in that in the interchanging device a switch cylinder 34 is arranged which has an actuating device (36—37), said cylinder permitting of the cutting out of the interchanging intermediary elements for the typing of clear text upon the typing device for instance alternately with the ciphered text.

8. Ciphering device as claimed in Claims 1 to 7 characterized in that in the driving lead for the interchanging intermediary elements (33) a switch (76) is arranged which during the typing of clear text cuts out the actuating mechanism of the interchanging intermediary elements.

Dated this 8th day of January, 1923.

MARKS & CLERK.

[This Drawing is a reproduction of the Original on a reduced scale.]

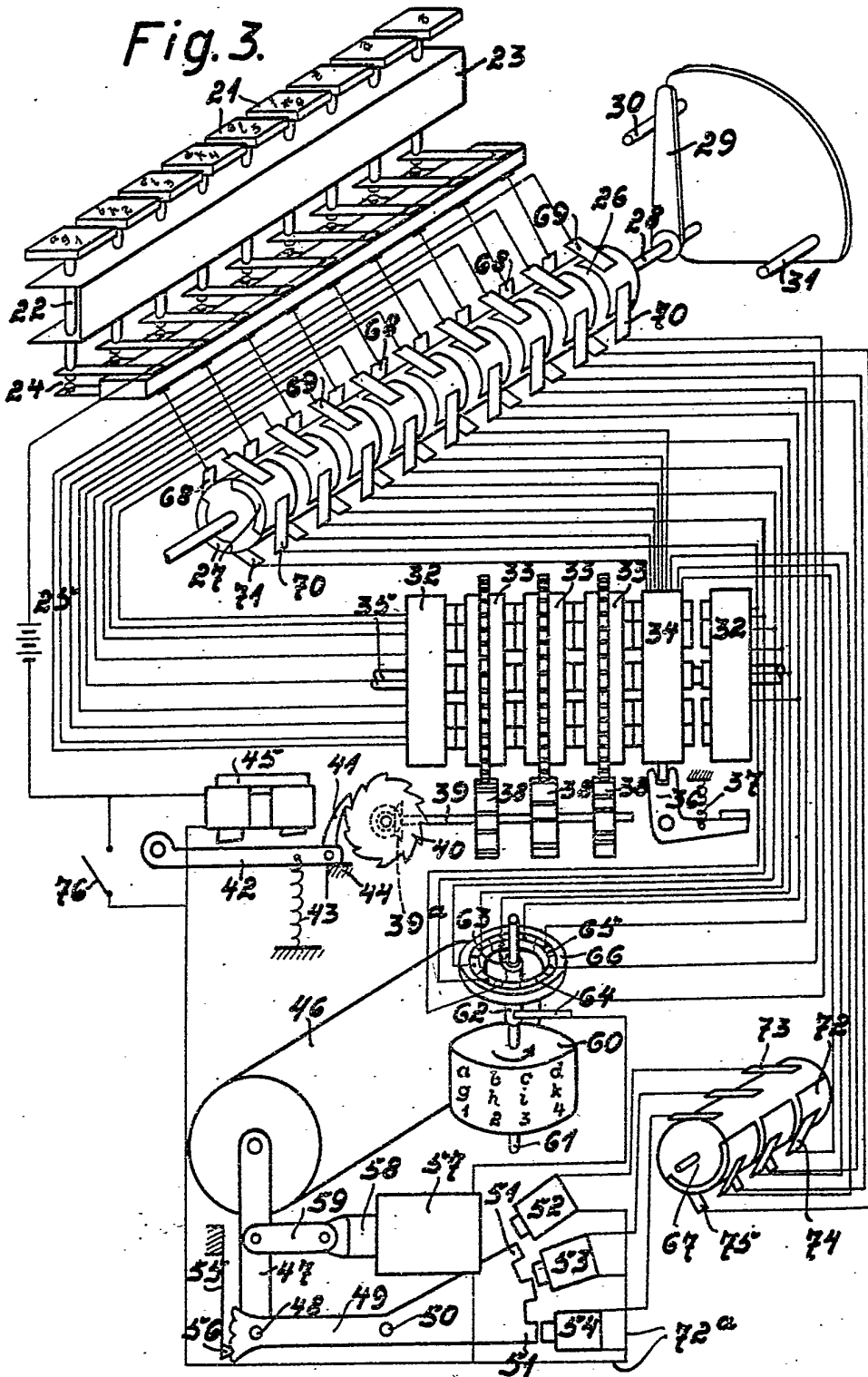


20
16

16

17
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Fig. 3.



SHEET 1

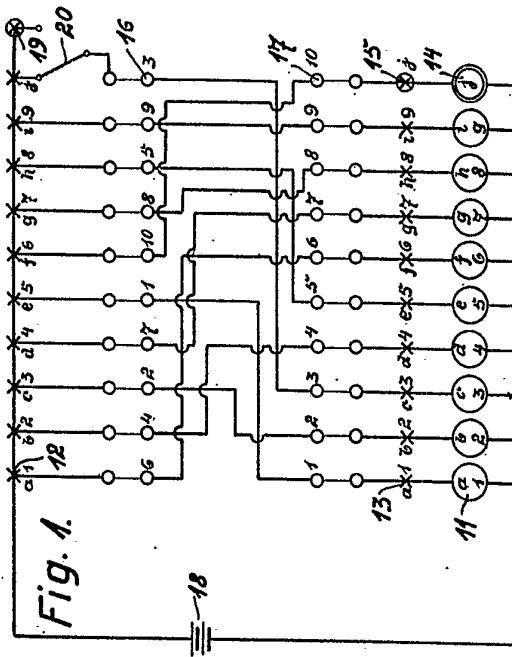


Fig. 1.

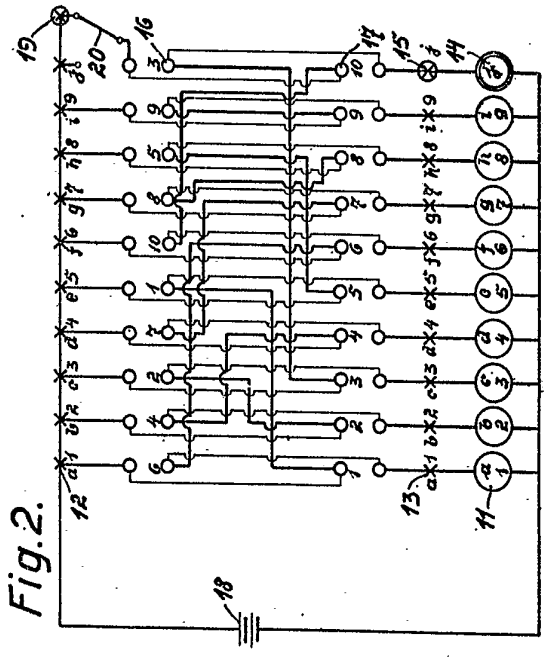
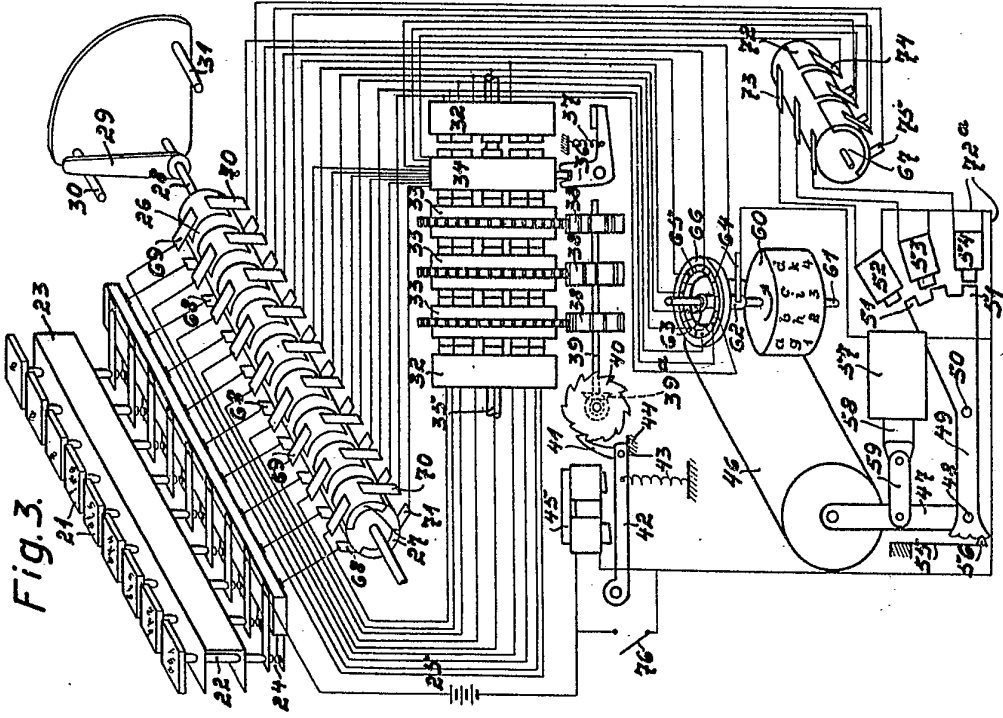


Fig. 2.

Fig. 3.



[This Drawing is a reproduction of the Original on a reduced scale.]