

Dec. 28, 1943.

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2,337,553

DEVICE FOR OPERATING MACHINES FROM CONTROL TAPES

Original Filed April 5, 1940 3 Sheets-Sheet 1

FIG. 1.

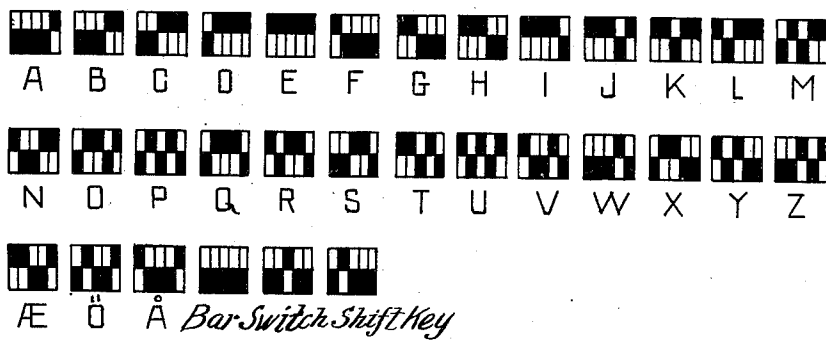


FIG. 2.

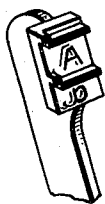


FIG. 3.

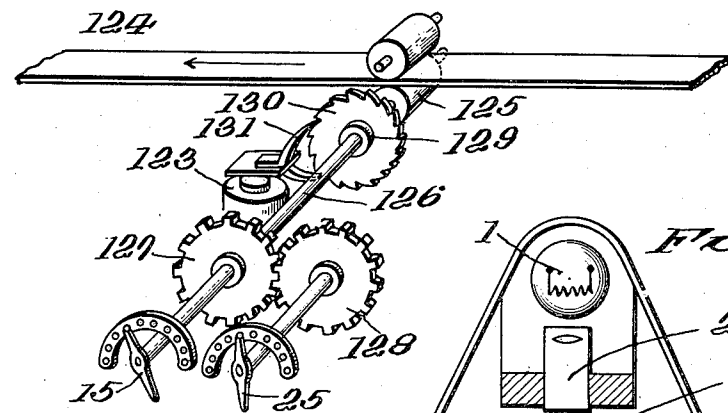
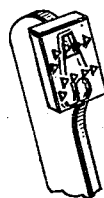
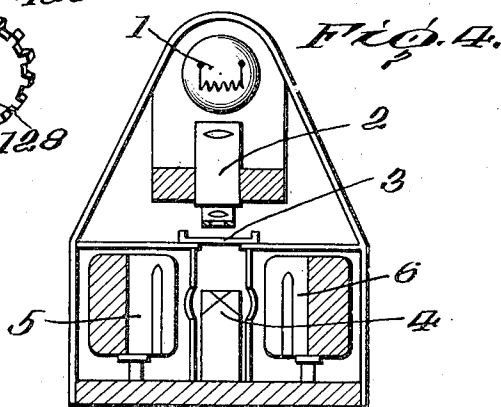


FIG. 5.



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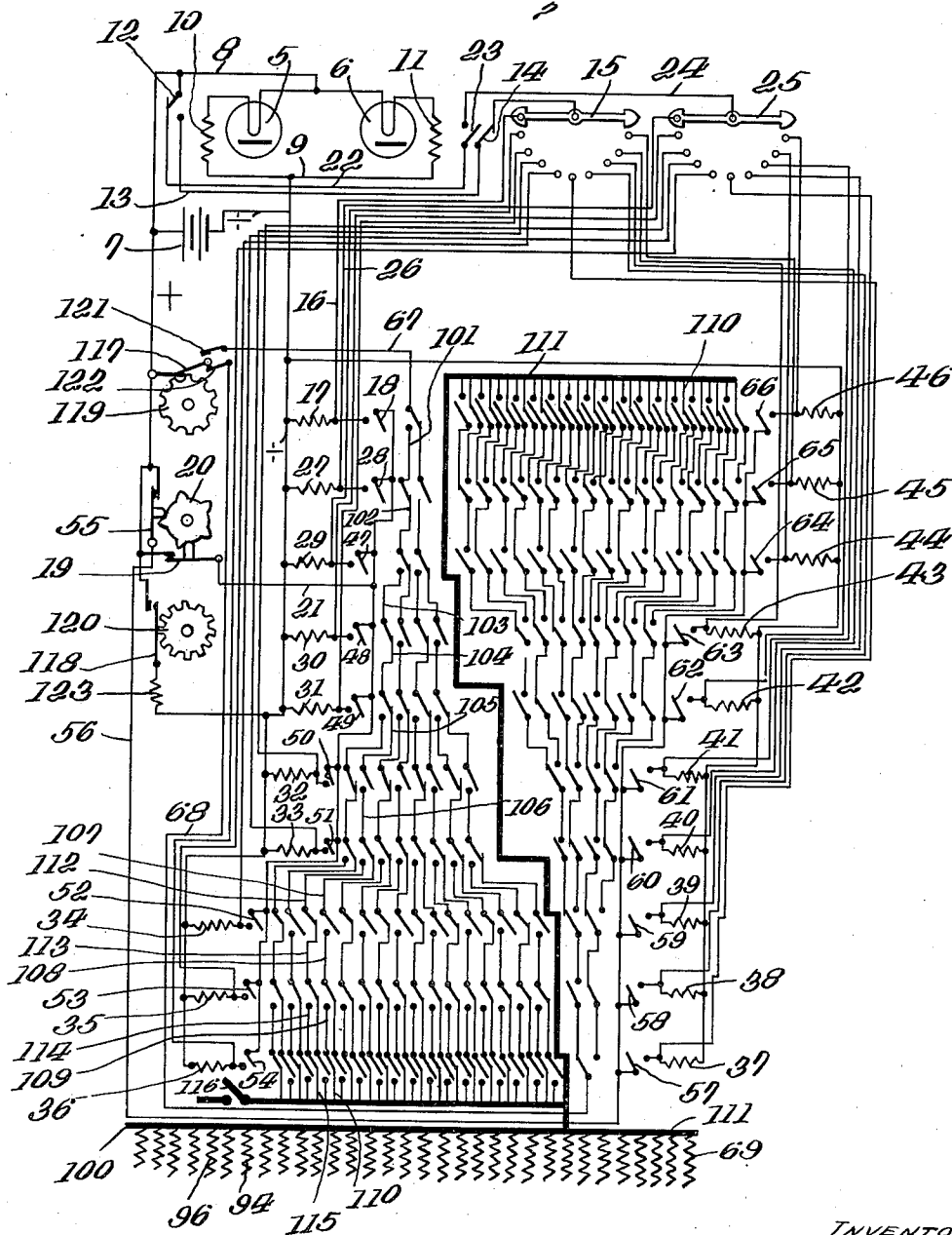
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DEVICE FOR OPERATING MACHINES FROM CONTROL TAPES

Original Filed April 5, 1940 3 Sheets-Sheet 2

FIG. 6.



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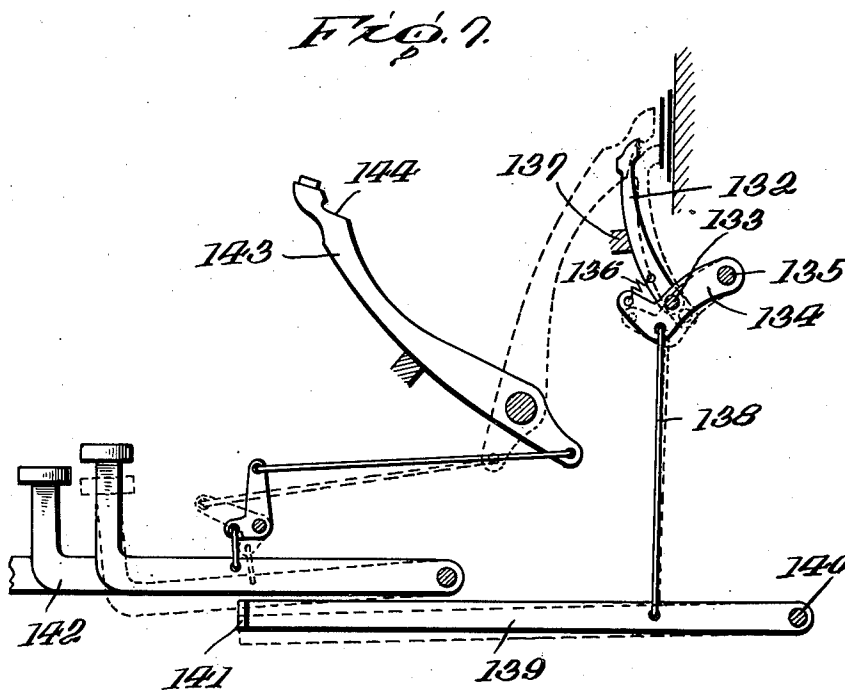
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DEVICE FOR OPERATING MACHINES FROM CONTROL TAPES

Original Filed April 5, 1940 3 Sheets-Sheet 3



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DEVICE FOR OPERATING MACHINES FROM
CONTROL TAPESRolf Hofgaard, Nordstrandshogda, pr. Oslo, Nor-
way; vested in the Alien Property CustodianOriginal application April 5, 1940, Serial No.
328,090. Divided and this application May 14,
1941, Serial No. 393,492. In Norway April 24,
1939

9 Claims. (Cl. 178—17)

This application is a division of application
Serial Number 328,090, filed April 5, 1940.

This invention relates to a device for operating
a machine from a control tape.

The present invention mainly has for its ob-
ject a type for typewriting, perforating or print-
ing, by means of which it is made possible to pro-
duce characters which are particularly adapted for
accurate mechanical interpretation, for in-
stance by means of photocells or contact springs.

In order to obtain this the types are so formed
as to produce by their engagement with the writ-
ing surface a picture composed of a number of
fields following after each other in the direction
of reading, each field comprising transversely to
the direction of reading a transparent or trans-
lucent, or light reflecting part and an opaque
or non-light-reflecting part.

Each character will accordingly comprise a
rectangular surface, consisting of two adjacent
strips lying in the direction of reading, said strips
being divided in the direction of reading into
dark or light fields in such a manner that a dark
field in one strip will always correspond to a
light field in the other strip and vice versa.

The number of characters which may be pro-
duced by means of types of the above mentioned
form as it will be understood are 2^n where n is
the number of the double fields comprising a light
and a dark section following each other in the di-
rection of reading.

For recording the letters of an ordinary alpha-
bet accordingly a character composed of five
double fields following each other in the direc-
tion of reading will be sufficient.

The types according to the present invention
may be printing types by means of which the dark
fields are produced by blackening, or perforating
types, by means of which the light fields are pro-
duced by perforation.

In both cases the mechanical interpretation of
the writing produced by means of the type may
be carried out by means of two cooperating photo-
cells to which light is supplied by means of a
suitable optical system from a source of light un-
der which the characters are moved in the direc-
tion of reading so that when one of the trans-
verse double fields is exposed to light from the
source of light, light will pass through the trans-
lucent or transparent part of the double field to
one of the photocells, whereas the other photocell
is not being illuminated.

By using two cooperating photocells in this
manner errors in interpretation are avoided, the

photocells being so connected that they transmit
an electrical impulse only in case one of the cells
is illuminated and the other not.

Instead of using photocells for producing elec-
trical impulses by means of the double fields of
the characters, it is also possible when the char-
acters are produced by perforation to use a pair
of cooperating contact springs which act in the
same manner.

When a character produced by means of a type
of the above mentioned kind passes below the in-
terpretation device consisting of two cooperating
photocells or contact springs, there will be trans-
mitted by means of one of the photocells or one
of the contact springs a number of impulses, each
character corresponding to a certain character-
istic sequence of impulses.

In order to cause this sequence of impulses to
actuate a certain recording member (for in-
stance the type arm of a typewriting machine, a
linotype-machine or the like) the impulse trans-
mitting photocells or contacts cooperate with a
controller, the movement of which is synchron-
ized in such a manner with the relative move-
ment between the system of photocells and char-
acters that it transmits each of the sequence of
impulses to different states of an automatic se-
lector of a conventional type.

In this manner each sequence of impulses
transmitted through the interpretation system is
caused to close the current circuit selected by
means of said sequence of impulses, said current
circuit serving to actuate the recording member
for the character corresponding to the sequence
of impulses.

It is preferred to use two controllers of the kind
specified, adapted to be cut in alternately so that
one controller effects the transmission of the se-
quence of impulses corresponding to one particu-
lar character during which time the other re-
turns to its starting position.

The types in accordance with the present in-
vention may be combined with types for ordinary
letters or characters so that the ordinary letter
or character as well as the character produced
by the new type are transferred to the writing
surface. For instance types in accordance with
the invention may be combined with ordinary
typewriter types so as to apply the new characters
on the sheet above or below the ordinary types.
In the case of perforation types these may also
be arranged so as to perform perforations in the
field covered by the ordinary characters.

Instead of using a type in accordance with the

invention for each character which it is desired to reproduce, the types in accordance with the invention may also be formed by the necessary number of type sections, arranged one after the other in the direction of reading, said sections being adapted to be adjusted transversely to the direction of reading in order to produce the dark or light field in one or the other of the two positions necessary to form the impulse combinations.

The relative displacements of said type sections may then be caused by means of an ordinary key-board, the keys for each of the ordinary characters being adapted to actuate one or more levers causing the displacement of the separate sections of the special type.

In the following, some forms of the invention will be described with reference to the diagrammatical drawings.

Fig. 1 is a picture of the printing surface of types in accordance with the invention corresponding to the characters usually found in an ordinary typewriting machine.

Fig. 2 is a perspective view of part of a machine type which is provided besides the ordinary characters with the new characters in accordance with the invention located above the ordinary characters.

Fig. 3 is a perspective view of part of a machine type provided with ordinary characters and perforating types.

Fig. 4 is a diagrammatical cross section of an interpretation device with two photocells.

Fig. 5 is a diagrammatic perspective view of a synchronizing device for two controllers.

Fig. 6 is a circuit diagram for an interpretation device with two photocells and two controllers.

Fig. 7 is a diagrammatic side view of the adjusting device for the separate sections of a composite special type.

When typewriting is carried out with the new types the new characters adapted for automatic interpretation will be located in the spaces between the lines on which the ordinary characters are found.

In the machine type illustrated in perspective view on an enlarged scale on Fig. 3 perforation types in accordance with the invention are so placed that they cover the normal letters A and A, and when this kind of types are used there will be produced a perforated writing in accordance with the new type system on the same line as the ordinary characters.

Referring to Fig. 4, 1 is a source of light, 2 a conventional optical system and 3 a translucent or transparent disk over which a strip provided with writing produced by the new types is moved in a direction perpendicular to the plane of the surface of the drawings.

4 is a system of prisms by means of which rays of light passing through the transparent or translucent parts of the characters are directed either against the photocell 5 or the photocell 6 according to whether one part or the other is adapted to let the light come through.

In accordance with the principle of interpretation by means of photocells 5 and 6 it is necessary that one or the other of said cells should always be in operation.

In case both photocells should simultaneously be in or out of operation, this means that an error has been made. Photocell 5 acts to operate relay 10 whereas photocell 6 acts to operate relay 11. See Fig. 6.

Supposing relay 10 to be energized contact spring 12 will connect the plus terminal of the battery through line 8 with line 13. Contact spring 14 remaining in its position of rest connects line 13 with controller arm 15, which is connected in its starting position through line 16 with relay 17 and further with line 9 and the minus terminal of the battery. Relay 17 acts to operate two contacts one of which, 18, closes a self-closing circuit for relay 17 from the plus terminal of battery over contacts 18 and 19 associated with contact wheel 20, so that line 8 is connected with line 21 over said contacts 18, 19 so as to close the circuit as specified to the minus terminal of battery.

In case relay 10 for photocell 5 is deenergized so that contact spring 12 interrupts the current circuit over relay 17, said relay will still be under current over the self-closing circuit specified until contact wheel 20 interrupts the said circuit by actuating contact spring 19.

In case relay 10 is not energized and current is supplied to relay 11, a current circuit will be closed in the same manner from the plus terminal of battery over line 8 which is now connected by means of contact spring 12 with line 22 and from then over contact spring 23, which is then in its closed position connected with line 24 and controller 25. The latter in its starting position as illustrated closes the circuit through line 26 to relay 27 and from then to the minus terminal of battery. Said relay 27 by means of contact spring 28 closes the same self-closing circuit as previously specified for relay 17.

Supposing that the contact arms 15 and 25 have moved one step in a counterclockwise direction it will be seen from the drawings that one of two current circuits must be closed, that is either the circuit for relay 29 or the circuit for relay 30. If arms 15 and 25 are in their third position, one of the corresponding relays 31 or 32 will be energized. In the fourth position one of the relays 33 or 34 and in their fifth position one of the relays 35 or 36 will be energized in the same manner.

If the arms 15 and 25 continue their simultaneous stepwise movement from the sixth to the tenth position it will be seen that current circuits will be closed in the same manner either over contact arm 15 to relays 37, 39, 41, 43 and 45 or over arm 25 to relays 38, 40, 42, 44 and 46. Relays 17, 27, 29, 30, 31, 32, 33, 34, 35 and 36 all have the same self-closing circuit closed over contact spring 19 and contacts 18, 28 as above specified as well as by further contacts 47, 48, 49, 50, 51, 52, 53, 54 as will be seen on the diagram.

In the same manner self-closing circuits are energized for relays 37—46 from the plus terminal of battery over line 8 and contact spring 55 to line 56 and over contact springs 57—66 for the respective relays 37—46.

By this stepwise displacement of the selector arms 15 and 25, relays 17 or 27, 29 or 30, 31 or 32, 33 or 34, 35 or 36 will be energized when the selector arms have passed the five first steps depending on whether one or the other of relays 10 and 11 receives current by means of photocells 5 and 6.

By the further displacement of arms 15 and 25 the next five steps will close current circuits either to relay 37 or 38, 39 or 40, 41 or 42, 43 or 44, 45 or 46.

If it is now presumed that either line 67 or line 68 is connected to the plus terminal of the bat-

tery, it will be seen that a current circuit is closed over one of the two sets of relays on magnets 69—100.

Presuming that in the first set of relays, relays 17, 29, 32, 34 and 35 receive current from line 21 over contacts 18, 47, 50, 52 and 53 the contact springs of which are in the closed position, line 67 will be connected with the following lines: 67—101—102—103—104—105—106—107—108—109 to line 110 which is the 26th line counting from the right, leaving relay 36 and joining cable 111, the lines of which lead in the same numerical order to each of the 32 relays 69—100, counting from the right.

Thus relay 94 will be energized, this being the 26th relay counting from the right. In case the relays of the other set, that is 37, 39, 41, 43 and 45 are under current, line 68 leading to the contact sets corresponding to relays 37—46, will also be connected with line 110 which also leads to relay 94 through cable 111.

The said magnets 69—100 in a known manner may be connected with a typewriting machine for releasing or operating the type arms of said machine.

Presuming photocell 5 to be operating in the upper part of a light ray and the photocell 6 in the lower part of the same light ray for recording characters, photocell 5, in order that the said relays, such as 17, 29, 32, 34 and 35 shall receive current, will be twice activated when photocell 6 is neutral, whereupon photocell 6 is activated twice when photocell 5 is neutral, whereupon photocell 5 is again activated whereas 6 remains neutral.

The five impulses thus interpreted will correspond to the type character S on Fig. 1. In case photocell 5 is activated in the same manner during the two first or five impulses whereby magnets 17 and 29 will receive current, whereupon the third impulse step activates photocell 6 so as to supply current to relay 32, line 67 will be connected with lines 101, 102, 103, 104, 105 and 106.

In case photocell 5 is now activated in the fourth impulse step, line 106 will not be connected with line 107 but with 112, which is again connected with line 113, and in case photocell 5 is now activated at the fifth impulse step line 113 will be connected with line 114 over relay 35 which is connected over relay 36 with line 115. Line 115 is connected through cable 111 with relay 95.

On Fig. 1 the said sequence of impulses is illustrated by means of the type indicated with the word "switch." Relay 95 consequently is not connected with any particular type arm but releases and operates a contact set for cable 111, whereby the lines, after the operation of said relay, are disconnected from the coils of magnets 69—100 and connected with other magnets. This may be up to 31 for the operation or releasing of other type arms or functions of a typewriting machine in case the 32 types illustrated on Fig. 1 should also be used for other type arms or functions of the typewriting machine.

In accordance with the embodiment forming the basis for circuit diagram on Fig. 6, the interpretation of the type characters is supposed to be transmitted to the type arms of an ordinary typewriting machine. The operation of any particular type arm also causes a stepwise movement of a contact wheel whereby contacts such as 19 and 55 as well as 117 and 118 are actuated.

The depression of any particular type key as well as the space key (the bar in front of the keyboard) as it is known releases the progres-

sion device of the typewriting machine whereby the carriage of the machine is moved one step when the key actuated is released and the type arm returns to its original position.

It will be immediately understood that besides this releasing device other movements may also be performed by the depression of a key. Thus one or more ratchet pawls may in a known manner engage the teeth of their respective ratchet wheels whereby these are moved one step by the depression of the key.

By placing one or more trailing arms in such a manner that their ends are in engagement with the disk associated with said ratchet pawls, they may be caused by means of notches or bosses on said disk to perform a movement, whereby contacts are closed or opened or in some cases remain uninfluenced during the stepwise progression.

On Fig. 6, 19, 55, 117 and 118 indicate such trailing arms actuated by means of disks 20, 119 and 120. During the stepwise progression contact arm 117 will move from a notch to the top of a tooth. The contact point of the arm which on Fig. 6 engages contact spring 122 when wheel 119 has moved one step, will engage contact spring 121. The stepwise progression of contact wheel 119 accordingly will cause the plus terminal of battery to be connected at every second step with line 68 and at the intermediate steps with line 67.

Disk 120 in the same manner actuates the trailer arm 118 which is moved from notch to notch during the stepwise progression whereby contact arm 118 performs a short contact closing, whereby a current circuit is closed from the plus line 8 through contact trailer 118 and relay 123 the second coil terminal of which is connected with the minus terminal of battery. Relay 123 thus receives an impulse for each step of movement carried out by disk 120.

Disk 20 is like disk 120 provided with small teeth or bosses which when they pass trailing arms 19 or 55, lift these during their passage so that the corresponding contacts which are ordinarily closed, are interrupted for a short period during the movement. As it appears from the figure the teeth of disk 20 are placed at such distance from each other that the contacts are interrupted alternately. Thus when disk 20 moves clockwise, the first step will cause movement of contact arm 55 whereas contact arm 19 is moved during the next step. Accordingly the self-closing circuits for the two sets of relays are interrupted alternately. Before the sequence of operation is described the synchronizing device for the paper ribbon from which the photocells receive their impulses, will be described with reference to Fig. 5. By means of relay 123 the movement of the paper ribbon is made dependent on the speed of operation of the typewriting machine. Paper ribbon 124 is supposed to be moved in the direction of the arrow, movement taking place at uniform speed past the photocells for instance, by means of a spring motor. The movement of the paper ribbon is transmitted to drum 125 on shaft 126. The movement of shaft 126 is transformed as indicated diagrammatically on Fig. 5 by means of gears 127, 128 to selector devices 15 and 25.

On sleeve 129 which is loosely mounted on shaft 126 is secured ratchet wheel 130 which is adapted to be released stepwise by means of magnet 123. Sleeve 129 is connected with shaft 126 by means of a spiral spring (not shown) which is wound by

the rotation of shaft 126 when sleeve 129 is maintained in its position by means of pawl 131.

When shaft 126 has performed a rotation corresponding to a movement of paper ribbon 124 caused by the impulse steps for up to two characters, that is in the present case ten impulse steps, the spiral spring will be completely wound so that shaft 126 can not be moved any further, whereby the movement of ribbon 124 stops being kept in position by pawl 131. In case magnet 123 receives an impulse ratchet wheel 130 is released.

The spiral spring connecting shaft 126 and ratchet wheel 130, moves the latter one step whereupon the ratchet wheel is again stopped by pawl 131, whereas shaft 126 is now free to rotate. The released spiral spring will again be wound until the whole stops again and is held by pawl 131 unless magnet 123 receives an impulse during this period. In this case paper ribbon 124 is moved evenly and uniformly.

The sequence of operations during the interpretation process in connection with the embodiment illustrated by diagram on Fig. 6 shall now be described.

It is presumed that ribbon 124 has been placed in front of the photocells so that the interpretation impulse of the first type is situated under the photocell combination, whereas at the same time the selector arms 15 and 25 are in their initial position.

Pawl 131 keeps the whole system locked. The carriage of the typewriting machine is now adjusted to one step in front of the place where the first type is to be printed. The battery which is adapted so as to be easily connected and disconnected is now supposed to be connected. A pressure on the space key (the bar) places the typewriting machine in operative position, whereas at the same time disks 20, 119 and 120 are moved one step. Disk 120 thereby transmits an impulse to relay 123 and paper ribbon 124 starts its uniform movement, the photocells receiving the five first writing impulses for the first type.

These writing impulses as described above are transmitted to the first set of relays, comprising relays 17, 27—36. Neither more nor less than five relays in the above mentioned set must be closed and these will remain closed, being maintained by means of the self-closing circuit over line 21. As contact arm 117 is now connected with spring 121, the current circuit will be closed from the plus terminal of battery over line 67 to cable 111 and one of relays 69—100 for printing of the type corresponding to the character interpreted.

The paper ribbon 124 continues its uniform movement as the spiral spring between sleeve 129 and ratchet wheel 130 permits a movement of up to 10 type impulses before it is completely wound. Consequently the selector arms continue their movement from the sixth to the tenth step, current circuits over the relays in set 37—46 corresponding to the next character being closed.

During this continued interpretation one of the magnets under the typewriting machine is actuated whereby the type first interpreted is printed and the disks 20, 119 and 120 are moved one step. Magnet 123 receives an impulse by means of which the spiral spring between sleeve 129 and ratchet wheel 130 is again released so that the paper ribbon 124 may continue its uniform movement.

Simultaneously with the impulse to locking magnet 123 contact arm 19 is moved, whereby

the relays in line 21 of the first contact set are cut out and all closed magnets are demagnetized. Further contact arm 117 is moved from contact spring 121 to contact spring 122, whereby as soon as five of the magnets 37—46 in the second contact set have received current, the corresponding magnet in set 69—100 is energized in order to actuate the corresponding type of the typewriting machine.

The contact wheels are hereby moved another step whereby the magnets in the second contact set are cut out whereas the current circuit of the contacts in the first contact set will be closed as soon as five magnets in this set have again received current, etc. In this manner the time necessary for moving a type against the cylinder of the typewriting machine as well as for moving the carriage one step to interpret the impulses produced by the next type is utilized.

The process of interpretation in accordance with the above mentioned process will take place with high velocity. In the case of an error in interpretation, for instance by the simultaneous illumination or non-illumination of both photocells, the five relays for the corresponding contact set will not be closed and no current circuit will be closed to one of magnets 69—100, whereby the interpretation process is interrupted.

Fig. 7 illustrates the manner in which a composite special type may be adjusted in connection with the keyboard of a typewriting machine.

The special type is here composed of five pivoted displaceable type arms one of which is shown and indicated with 132. Each of the type arms 132 is provided with an element for perforation or blackening so that they are adapted by adjustment transversely to the direction of reading to form a complete type of the kind illustrated on Fig. 1.

The levers 132 are pivoted on trunnions 133 on levers 134 adapted to pivot about stationary trunnions 135. A spring 136 maintains the type arms 132 in their left hand position against a stationary stop 137.

Levers 134 are connected by means of links 138 with levers 139, pivoted on stationary trunnions 140. Levers 139 are arranged in pairs, one pair for each of levers 134 being located on each side of the keyboard, and the free ends of these pairs are interconnected by means of cross bars 141 so as to form a number of U-shaped hoops which are all pivoted on the stationary trunnion 140. The cross bars 141 for each of the U-shaped hoops corresponding to the several levers 134 and 132, are provided with notches so as to be actuated by the depression of the several keys 142 in case there is no notch in the cross bar 141 directly below said key.

The depression of a particular key will therefore move one or more of levers 134, 132 into the position indicated in dotted lines and contact or perforating members of said arm 132 will then be displaced to the lower part of the type character as illustrated on Fig. 1.

The depression of one of the keys of the typewriting machine in this manner will cause the adjustment of the special type corresponding to the type of the machine in such a manner that when the type arm 143 of the typewriting machine arrives in its striking position as illustrated in dotted lines, it will at the same time engage the special type composed by means of arms 132 with its striking surface 144 and the character of the special type will then be printed

on the printing surface immediately below the normal characters if such are employed.

Obviously the arrangement may also be used in case no ordinary types are placed on arms 143. I claim:

1. In a device for the automatic interpretation of characters having two sets of light and dark fields, two photocells arranged to be respectively associated with the two sets of light and dark fields, means to cause relative movement between the photocells and the characters to be interpreted, means connecting said photocells to transmit an impulse when one only of said photocells is presented with a light field, a first selector having a plurality of stages and capable of stepwise movement from one stage to another, an automatic selector having individual selector stages each under the influence of a respective stage of said first selector, means connecting said selectors electrically to receive impulses in response to the transmitting of the electrical impulses by said photocells, and means synchronizing the stepwise movement of said first selector and the relative movement between said characters to be interpreted and said photocells whereby impulses are selectively transmitted to the successive stages of said automatic selector.

2. A device as described in claim 1 wherein said photocells control a pair of relays respectively, each of the relays having a normally closed switch unit and a normally opened switch unit which is closed by the energization of the relay when the respective photocell is presented with a light field, the normally closed switch unit of each of said relays being connected in series with the normally opened switch unit of the other relay whereby both circuits are opened when both photocells are presented with either a light or a dark field.

3. In a device for the automatic interpretation of characters having two sets of light and dark fields, two photocells arranged to be respectively associated with the two sets of light and dark fields, means to cause relative movement between the photocells and the characters to be interpreted, means connecting said photocells to transmit an impulse when one only of said photocells is presented with a light field, two sliding contact selectors mechanically related to be moved together and capable of stepwise movement synchronized with the relative movement between the photocells and the characters to be interpreted, means alternately connecting said contact selectors to receive impulses upon the transmitting of impulses from said photocells, two automatic selector assemblies each having indi-

vidual selector stages, and circuit means electrically connecting each automatic selector to control a respective stage of one of said automatic selectors whereby impulses are selectively transmitted to the respective contact selectors and thence are transmitted to the successive stages of the automatic selectors.

4. A device as described in claim 3 wherein each of said contact selectors is formed by a swinging contact arm successively engaging a plurality of stationary contacts.

5. A device as described in claim 3 wherein said contact selectors are formed by two assemblies mechanically connected to be operated together and each of which includes two separate arms.

6. A device as described in claim 3 wherein said contact selectors cooperate in a cycle of operation to first set up an electric circuit in one of said automatic selector assemblies and then in the other of said automatic selector assemblies.

7. In a device for the automatic interpretation of characters having a plurality of rows of light and dark fields where a predetermined set comprises a character, a photocell assembly arranged to be associated with the light and dark fields including a photocell responsive to each of the rows, a primary selector assembly capable of stepwise movement, means to move synchronously said primary selector assembly and the characters whereby the fields are presented to the photocell assembly, a secondary selector assembly adapted to receive impulses and set up a selected circuit, said secondary selector assembly including a plurality of selector units whereby the circuit corresponding to one character may be set up and maintained while the circuit corresponding to another character is being set up, and circuit means connecting said photocell assembly with said primary selector assembly and connecting said primary selector assembly with said secondary selector assembly.

8. A device as described in claim 7 wherein the means for synchronously moving the selectors and the characters includes a plurality of cyclic control units one of which determines which of said selector units is to be energized and another of which operates a circuit to start a new cycle of operations.

9. A device as described in claim 7 wherein a cyclic control means is provided to de-energize each of said selector units when the character has been recorded.

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