No. 688,939. Patented Dec. 17, 1901.

F. E. P. EHRLICH.

APPARATUS FOR AUTOMATICALLY PRODUCING AN UNLIMITED NUMBER OF COPIES.

(Application filed Aug. 11, 1900.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 8.

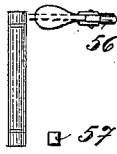

Fig. 9.

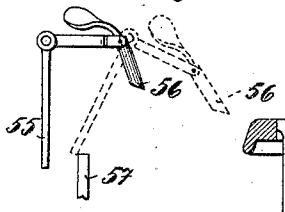

Fig. 1.

Fig. 5.

Fig. 6.

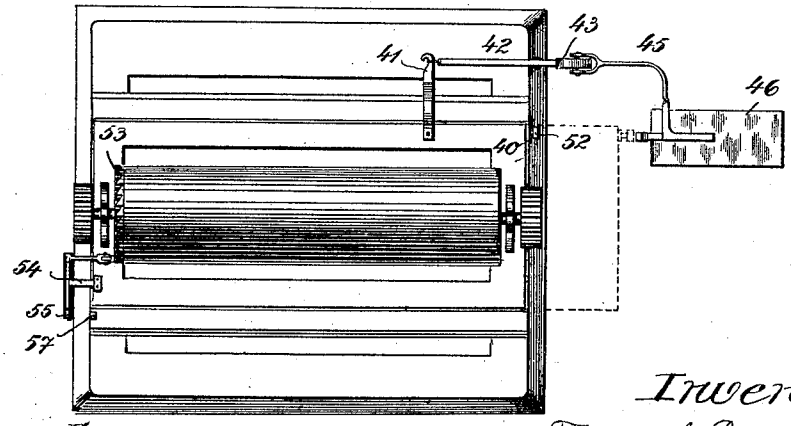

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Fig. 2.

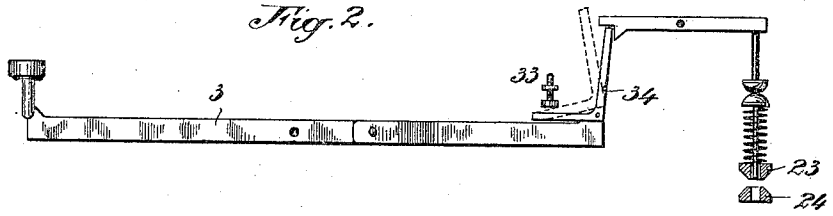


Fig. 3.

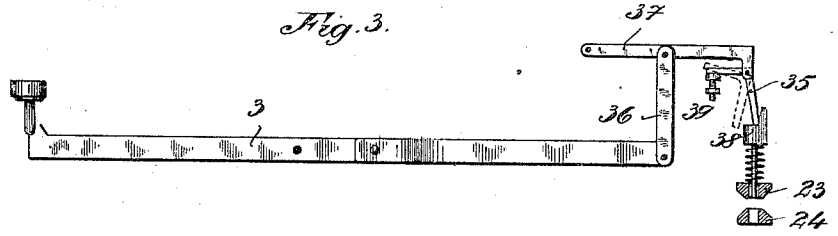


Fig. 4.

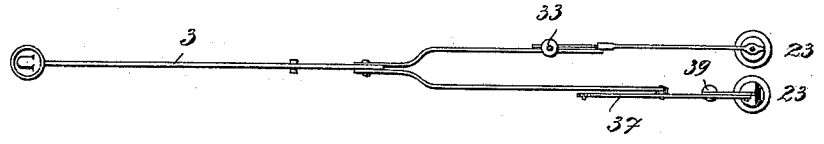
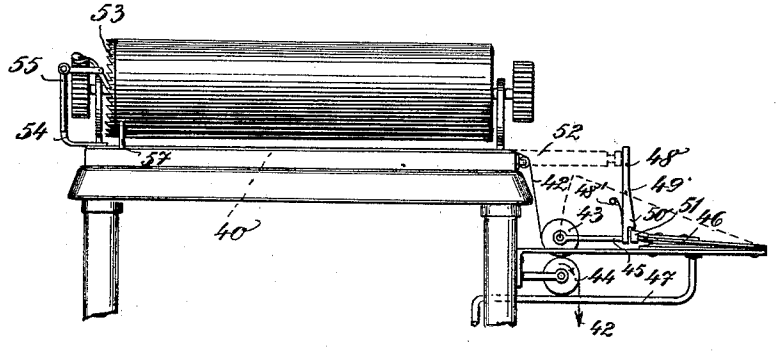


Fig. 7.



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(Application filed Aug. 11, 1900.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 10.

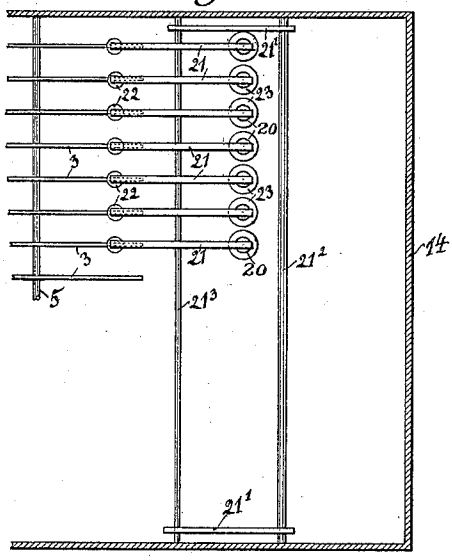
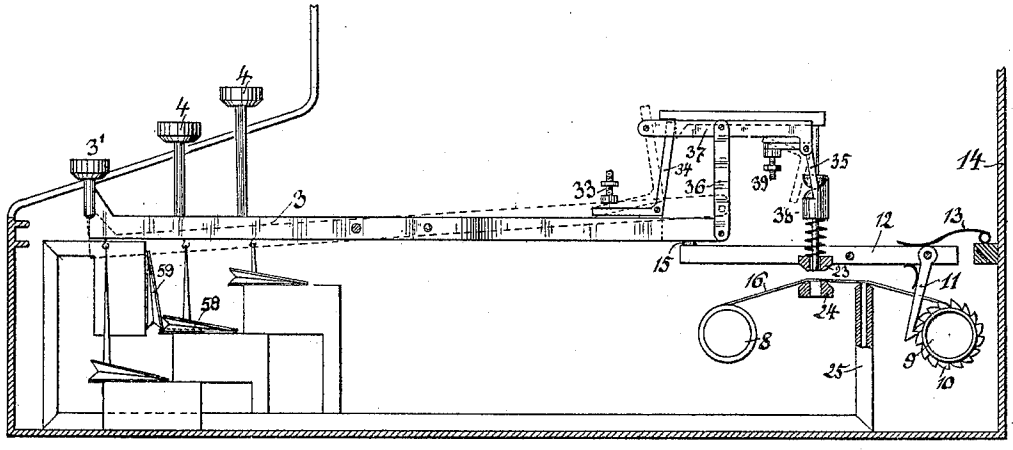


Fig. 11.



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UNITED STATES PATENT OFFICE.

FRIEDRICH ERNST PAUL EHRLICH, OF LEIPSIC, GERMANY.

APPARATUS FOR AUTOMATICALLY PRODUCING AN UNLIMITED NUMBER OF COPIES.

SPECIFICATION forming part of Letters Patent No. 688,939, dated December 17, 1901.

Application filed August 11, 1900. Serial No. 26,541. (No model.)

To all whom it may concern:

Be it known that I, FRIEDRICH ERNST PAUL EHRLICH, a subject of the German Emperor, residing at Leipsic, in the Kingdom of Saxony, Germany, have invented an Apparatus for Automatically Producing an Unlimited Number of Copies, (for which patents have been applied for in Germany, dated February 1, 1900, and in Great Britain, dated March 14, 1900,) of which the following is a specification.

My invention relates to an apparatus for automatically producing any desired number of copies on a type-writer; and it consists of means whereby perforations are punched in a strip of suitable material at the same time the original paper is written, this perforated strip being afterward for the purpose of obtaining copies of the original document passed over openings of a pneumatic device combined with a type-writer in such a manner that when a perforation of the strip registers with one of the said openings a key-lever is depressed and the corresponding type thereby caused to strike against the paper in the same manner as if the machine was operated by hand.

My invention embodies also means for the automatic spacing of the lines and returning of the paper-carriage, so that one person can take charge of a number of type-writers to which my reproducing apparatus is applied. The completion of a page or copy may be indicated by the striking of a bell connected with the aforesaid apparatus.

My invention possesses over the existing processes of reproduction of type-written documents the marked advantage that an unlimited number of clearly and sharply printed copies may be obtained.

The invention consists in the construction and combination of parts for effecting the described results, which parts are shown in the accompanying drawings and hereinafter described and claimed.

In the drawings, Figure 1 is a cross-section showing the punching device and the mechanism for feeding the strip by the space of one perforation, both devices being actuated by the keys of the type-writer and also the pneumatic reproducing device. Figs. 2 and 3 show the shifting key-lever by means of which the change from caps to small letters, and vice versa, is effected. Fig. 4 shows a plan view of the shifting key. Fig. 5 shows a portion of the perforated strip. Fig. 6 is a plan view of the machine and of the mechanism for returning the paper-carriage when a line is finished. Fig. 7 is a partial elevation of this mechanism. Figs. 8 and 9 are details of the line-spacing mechanism. Fig. 10 is a detail plan view showing the manner of supporting the perforating-levers. Fig. 11 is a broken cross-sectional view showing the punching mechanism operated by the shifting key-lever for printing capital letters and the pneumatic mechanism for operating said shifting-lever.

The type-bars carrying the type-blocks are connected in the usual manner to the key-levers 3, pivoted in 5 by means of the hangers 2, and are operated by the keys 4, which on being depressed cause the type-blocks to strike against paper 7, placed around the platen 6. The operation of the type may of course be also effected in any other suitable manner.

The strip which is to be perforated is conducted over rollers 8 and 9, one of which is provided with ratchet-wheel 10, with which the pawl 11 engages. This pawl is suspended at the end of a double-armed lever 12, which is kept depressed by a spring 13, attached to the rear of the casing. The other arm of lever 12 is provided with a projection 15, which bears on the shorter free end of the key-lever 3. If now the key-lever is depressed, spring 13 causes the pawl connected to lever 12 to move downward and slide past one tooth of the ratchet which it engages, so that on the release of the key-lever 3 and consequent upward movement of the pawl a partial rotation of the roller 11 and the forward feed of the strip 16 by the amount of the space of one letter is effected. The perforation of the strip is effected at each depression of a key-lever by means of one of a series of small punches 17, corresponding to the series of key-levers. Each of these punches is held in its position of rest by a spring 18, and each punch is provided at its upper extremity with a button 19, against which bears another button 20, adjustably connected to a double-armed lever 21, the opposite end of which is provided with a button 22, bearing on the corresponding key-lever 3. The punches 17 are provided above

and below the paper strip to be perforated with guides 23 and 24, the latter acting as matrices for the paper strip. The levers 21 are pivotally supported in a frame 21′, (see Fig. 10,) so that upon the turning of the frame into the position shown in dotted lines in Fig. 1 the levers 21 are put out of action. By means of this device a perforation is made on the said strip of paper for each letter and each sign as the corresponding key-lever is depressed. If now a duplicate of the type-written document is required, the punching device is thrown out of action, which may be done by turning the lever-frame 21′ to and locking it in the position shown in dotted lines in Fig. 1. For reproducing the writing by the aid of such perforated sheet this latter is caused to pass over the openings of a series of suction-passages 25, corresponding to the series of punches 17, there being a passage for each key-lever. As the sheet is moved, whenever a perforation comes over the opening of a passage 25 air is sucked into the latter and causes a diaphragm 26 provided at the other end of said passage to move a double valve 27 to close a port 29 of a chamber 31^a, which chamber communicates with a bellows 31, which is connected to the corresponding key-lever 3, and to open a port 28, connecting said chamber 31^a with the vacuum-chamber 30, which is exhausted by means of a suitable air-exhausting device. The vacuum-chamber 30 is thus put in communication with the bellows 31, and as the bellows collapses the key-lever 3, connected thereto, is drawn down and made to operate the type-bar in the usual manner. When the passage 25 is again closed by the unperforated part of the paper strip, the air is exhausted from the passage 25 through a small aperture 32, connecting the passage with the vacuum-chamber 30, and the pressure being thus balanced on the two sides of the diaphragm the atmospheric pressure acting through the port 29 will force the valve 27 inward again and the valve and diaphragm 26 will return to the position shown in Fig. 1.

Figs. 2, 3, and 4 show the arrangement of the shifting key-lever for capital letters, the free end of which is forked and provided with small levers, the purpose and operation of which I shall now describe. One part of such mechanism is shown in Fig. 2 and the other part in Fig. 3. The said levers act in such a manner that on the key being depressed the arrangement shown in Fig. 2 effects a perforation, the punching device being thereupon immediately released through the adjustable stop 33 striking against the shorter arm of a bell-crank lever 34 and bringing the latter to the position shown in dotted lines in Fig. 2, so that the connection between the key-lever and punching device remains interrupted so long as the key is depressed, and any number of "caps" can be printed and the corresponding holes perforated in the strip. The part of the levers shown in Fig. 3 acts to re-release the shifting key. Its action is as follows: The end of the shifting key-lever is connected by means of link 36 to a lever 37, fulcrumed at one end, the other end having attached to it a bell-crank, the longer arm 35 of which comes to bear on the top stud of the punching device when the shifting key-lever is depressed. When this latter is released, link 36 pulls lever 37 downward and causes the bell-crank pivotally attached thereto to actuate the other punching device, while at the same time the shorter arm of the bell-crank comes in contact with an adjustable stop 39, so that the bell-crank comes into the position shown in dotted lines in Fig. 3, and the punching device is thereby disconnected from the key-shifting lever, the spring of the punch bringing it back to its original position. The shifting key effects thus two perforations, one when the lever is depressed and the other when it is released. In the automatic reproduction of copies one of the perforations serves for the depression of the shifting key-lever, the corresponding bellows being exhausted and the key-lever being held down by a catch or a locking device until the other perforation, registering with a suitable air-duct, causes another set of bellows connected to the catch or the locking device to so act that the latter is set free and the shifting-lever is released and printing with small letters is resumed.

For the catch or locking device to hold the shifting key-lever in its depressed position I preferably provide a bellows 59, (see Fig. 11,) arranged at an angle to the shifting-lever bellows 58 and operated in a similar manner to the shifting-lever bellows and other lever-operating bellows. The bellows 58 and 59 are controlled by the admission of air to the air-passages 25, corresponding, respectively, to the holes punched by the depression of the shifting key-lever and by the release of the same. The bellows 59 is so located with relation to the bellows 58 that when the latter is collapsed by the passage of a perforation over the opening of its corresponding air-passage 25 the bellows 59 will act to lock the bellows 58 in its collapsed position, as will be seen from Fig. 11, in which the collapsed position of the bellows 58 is indicated by dotted lines. The shifting-lever is operated by the collapse of the bellows 58, and it will thus be held in its depressed position during the printing of the capital letters and until the perforation corresponding to the release of the shifting key-lever registers with the proper air-passage 25, which is the one corresponding to the bellows 59. Thereupon the bellows 59 will be collapsed and the bellows 58 will be released and the shifting-lever will return to its normal position for the printing of small letters.

The strip, part of which is shown in Fig. 5, has the same width as the row of closely-lying air-passages. It must of course be executed

with great accuracy, so that the perforations register exactly with the proper corresponding air-duct outlets.

I will now proceed to describe the mechanism for returning the paper-carriage to its normal position when a line is completed and also for turning the paper-roll by the space of a line when the paper-carriage is again in its initial position ready to start a fresh line. When writing the original document, the paper-carriage is shifted in the usual step-by-step manner; but it is obvious that some automatic device must be provided to return it to its initial position when the pneumatic reproducing device is used. With this object in view I provide on the key-board a special lever with punching device of the kind hereinbefore described, which the operator has to depress each time a line of the original document is completed, a corresponding perforation being thereby produced in the strip. In the production of the copies the latter perforation comes to register with the air-passage 25 of the pneumatic device leading to bellows-controlling apparatus, such as before described, which is connected by a pipe 47 to a pair of bellows 46, somewhat larger than the key-lever bellows and mounted on a suitable part of the type-writer.

Supposing the paper-carriage to be in its initial position on the right-hand side of the type-writer, bellows 46 will then be expanded, as indicated by dotted lines in Fig. 7. When the line is completed and the paper-carriage comes to rest in the position on the left, the aforesaid perforation in the edge of the strip registers with the corresponding air-passage 25, and the air is exhausted from bellows 46 and the bellows collapses, as shown by full lines in Fig. 7, and a friction-roll 43, mounted in a bracket 45, carried by the movable side of the bellows, is thereby carried downward to coact with a second roll 44, mounted in a bracket on the type-writer frame and rotated continuously by suitable means. A ribbon 42, attached to the paper-carriage, runs between these rolls, and when the roll 45 is moved into position to coact with the roll 44 the ribbon gripped between the rolls will draw the carriage back toward the right. When the bellows 46 is collapsed, it is held in its collapsed position by a double-armed lever 48, pivoted at 49 and acted upon by a spring 48′, a notch 50 at the lower end of the lever engaging a projection 51 on the bellows. The roll 43 is thus held in its operative position and the return movement of the carriage continues until the carriage approaches its initial position, whereupon a stop attached to the carriage strikes against and moves lever 48, and thereby releases the bellows 46, which then returns to its normal position and carries the roll 43 away from the roll 44. As the platen on reaching its end position on the left was turned by an amount equal to the space between two lines, the writing of a new line can now be at once begun.

For the purpose of turning the platen by the space of a line when it reaches the end of its traverse I provide on the end of the said platen a crown of ratchet-teeth 53 and on the carriage-slide 40 a bracket 54. A bell-crank lever 55, pivotally attached to the top of this bracket, has its horizontal arm fitted with a pawl 56, the end of which is so shaped as to be capable of engaging with the space between any two teeth of the aforesaid crown 53. The top plate of the type-writer is provided with a stop 57, which just before the paper-carriage reaches the end of its traverse causes bell-crank 55 to assume the position shown in dotted lines in Fig. 9, so that pawl 56 engages with the teeth provided at the end of the paper-roll. The further movement of slide 40 causes a further depression of pawl 56, whereby the platen is turned by the amount equal to the space of a line.

The whole of the operation of the type-writer may be effected automatically by the perforated strip. The kind of type-writer plays no part. Only the small lever connections between the key-levers and the punching devices must be varied according to the construction of the type-writer to which the device has to be adapted.

It will be seen that the main idea of my invention is the application of special punching devices to type-writers, one for each operation, for the purpose of producing a perforated strip while the original or first copy is being made in the usual manner by hand, and thus to enable the operator to reproduce afterward automatically with the assistance of pneumatic devices any number of copies of the said original by causing the said perforated strip to pass over air-passages.

I may of course effect the various operations in reproducing by a compressive action of the air—that is, by forcing the air out of the various valves or passages—in lieu of effecting the operations by suction of the air in the manner hereinbefore described.

Having described my invention, I declare that what I claim, and desire to secure by Letters Patent, is—

1. An apparatus for automatically producing any desired number of copies on a type-writer comprising in combination with the type-writer punching devices actuated each by a two-armed lever bearing on the short arm of the key-lever, spring-punches, pawl-and-ratchet mechanism for feeding the paper strip to be perforated to the punches, and means for actuating the pawl-and-ratchet mechanism by the key-levers, essentially as and for the purpose described.

2. An apparatus for automatically producing any desired number of copies on a type-writer comprising in combination with the type-writer, punching devices, means for throwing the punching devices out of action, pawl-and-ratchet mechanism for feeding the previously-perforated strip of paper over the air-ducts of a pneumatic device, and mech-

anism for depressing a corresponding key of the type-writer when a perforation of the strip registers with one of the air-ducts of the said pneumatic device, essentially as and for the purpose described.

3. An apparatus for automatically producing any desired number of copies on a type-writer comprising in combination with the type-writer, mechanism for feeding a perforated strip of paper over the air-ducts of a pneumatic device consisting of the said air-ducts of a chamber with flexible membrane and of double-seated valve and of bellows connected with the key-levers of the type-writer, essentially as and for the purpose described.

4. An apparatus for automatically producing any desired number of copies on a type-writer comprising in combination with the type-writer, mechanisms for feeding a perforated strip of paper over the ducts of a pneumatic device, mechanism for actuating the key-levers of the type-writer by said pneumatic device and a device for returning the paper-carriage to its initial position whenever a line is completed consisting of a continuously-rotated roller, a ribbon attached to the paper-carriage and passing around the said roller, a second roller connected with a pair of bellows which by means of the pneumatic device is caused to collapse on a line being finished and so located that on the bellows collapsing, the second roller presses the ribbon against the continuously-rotated roller, double-armed lever for locking the collapsed bellows and stop fixed to the paper-carriage for tilting the said lever and releasing the bellows on the carriage reaching the end of its return movement, essentially as and for the purpose described.

5. An apparatus for automatically producing any desired number of copies on a type-writer comprising in combination with a type-writer, mechanism for feeding a perforated strip of paper over the air-ducts of a pneumatic device, means for actuating the key-levers of the type-writer by said pneumatic device, means for returning the paper-carriage to its initial position on a line being completed and line-spacing device consisting of a crown of ratchet-teeth on one end of the platen, bracket attached to the frame of the type-writer, bell-crank lever with pawl attached to the bracket and stop on the type-writer frame, all essentially as and for the purpose described.

6. An apparatus for automatically producing any desired number of copies on a type-writer comprising in combination with the type-writer, punching devices actuated by the key-levers, forked shifting key-lever and means in connection with the prongs of this shifting key-lever for making one perforation in the paper strip on the shifting key-lever being depressed and another perforation on the lever being released, essentially as and for the purpose described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

FRIEDRICH ERNST PAUL EHRLICH.

Witnesses:
RUDOLPH FRICKE,
CHAS. J. BURT.