No. 765,057. PATENTED JULY 12, 1904.

M. WEHRLIN.

APPARATUS OPERATED BY A PERFORATED BAND FOR CASTING SPACES.

APPLICATION FILED MAY 5, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

FIG. 1.

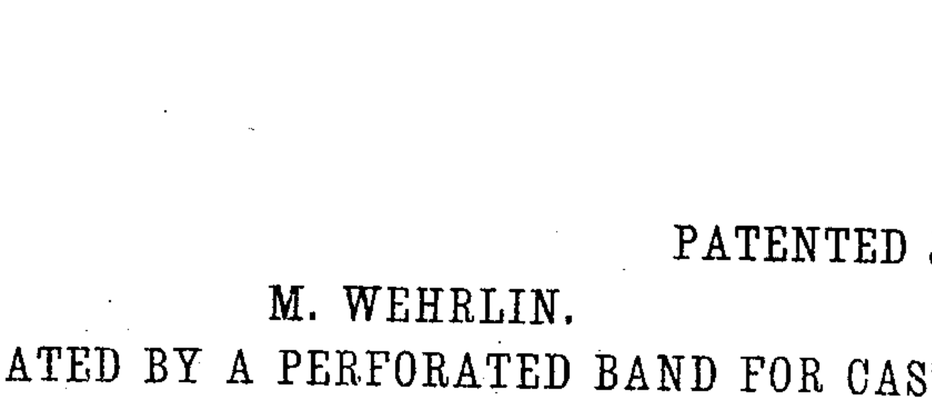
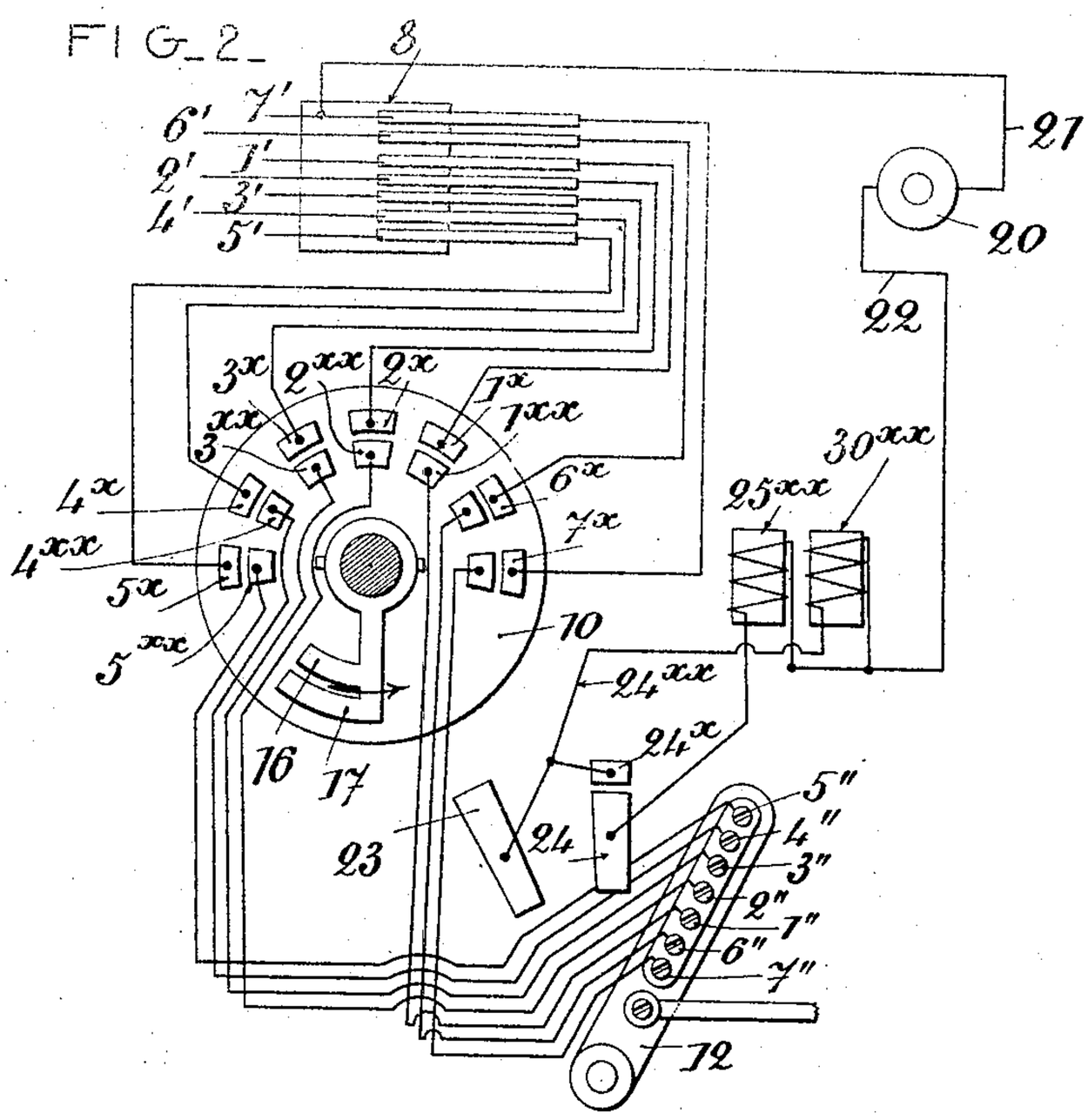


FIG. 2.



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NO MODEL. 4 SHEETS—SHEET 2.

FIG. 4.

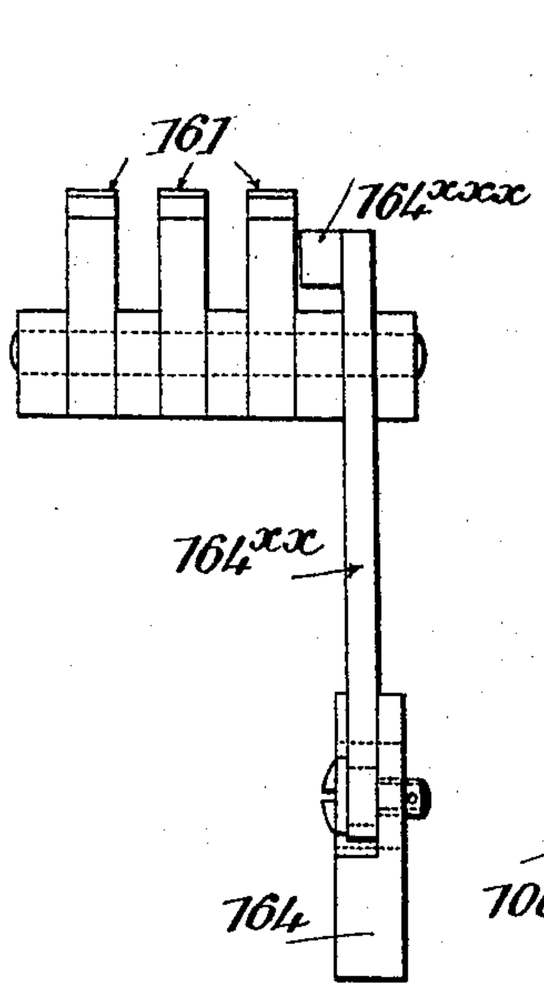


FIG. 3.

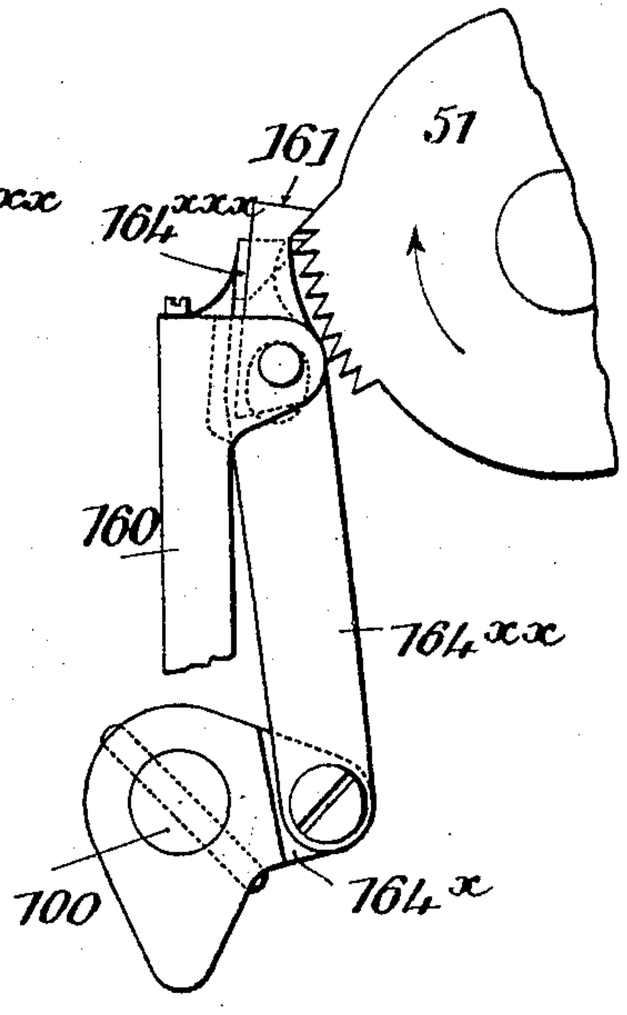
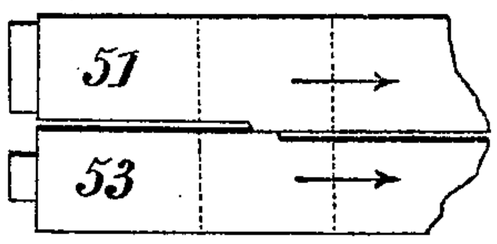


FIG. 5.



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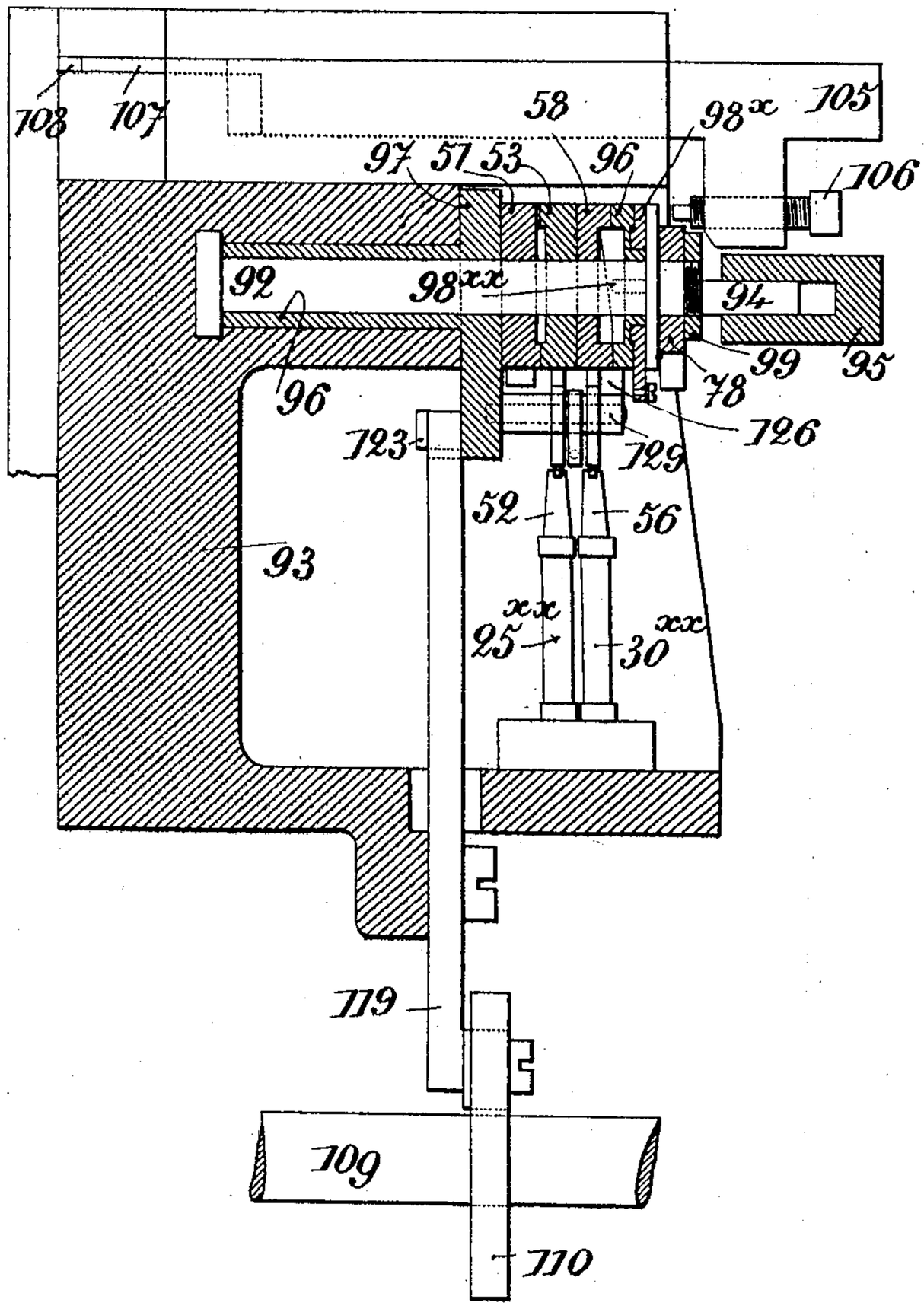
NO MODEL. 4 SHEETS—SHEET 3.

FIG. 6.



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NO MODEL. 4 SHEETS—SHEET 4.

FIG. 7.

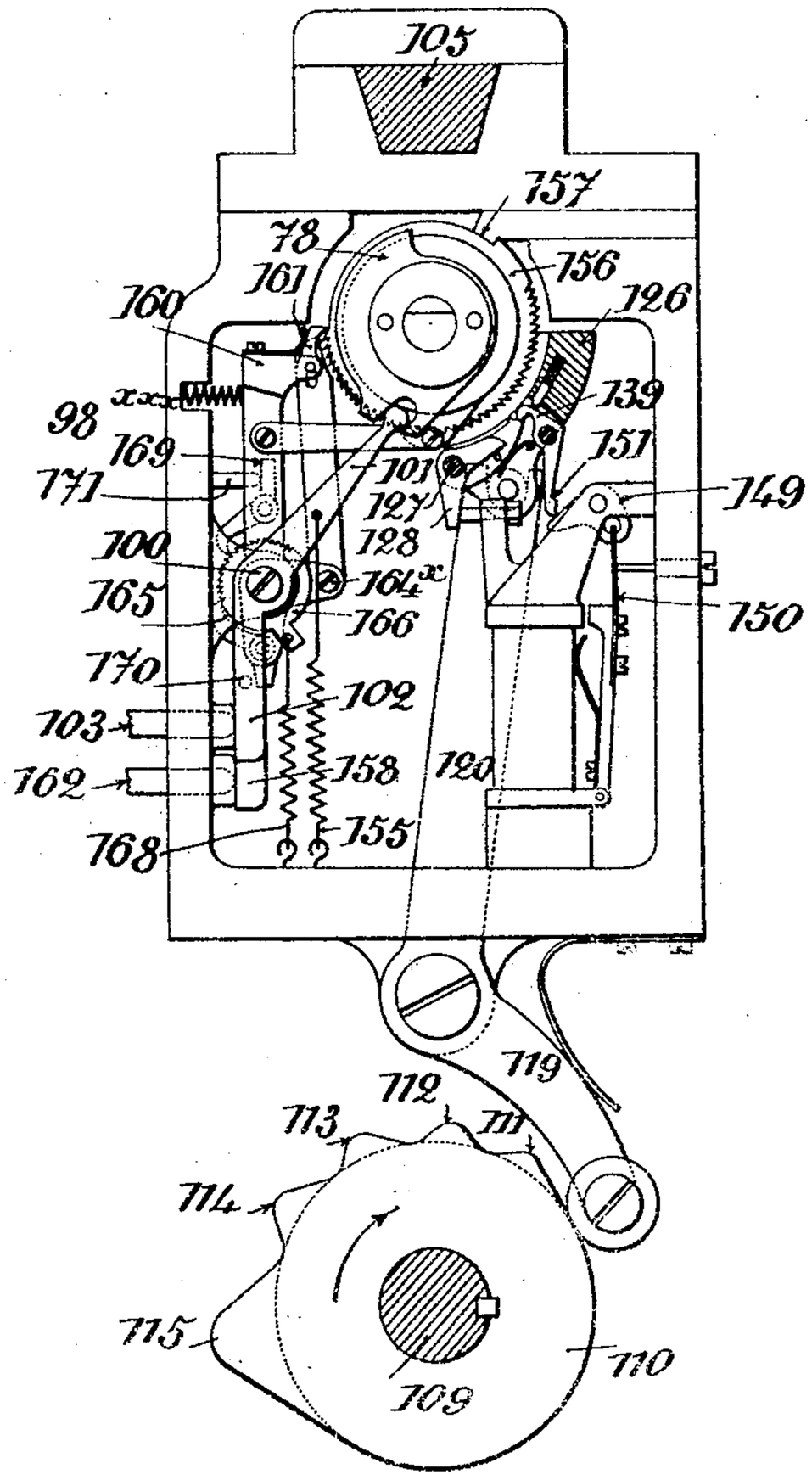
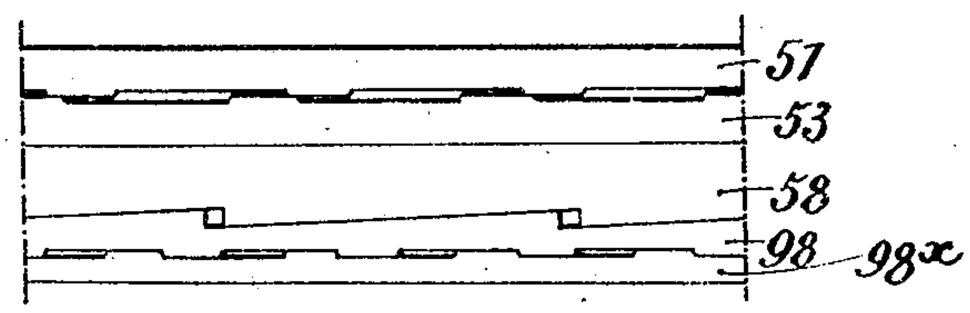


FIG. 8.



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No. 765,057. Patented July 12, 1904.

UNITED STATES PATENT OFFICE.

MAURICE WEHRLIN, OF PARIS, FRANCE, ASSIGNOR TO COMPAGNIE INTERNATIONALE DE L'ELECTRO-TYPOGRAPHE MERAY & ROZAR, OF PARIS, FRANCE.

APPARATUS OPERATED BY A PERFORATED BAND FOR CASTING SPACES.

SPECIFICATION forming part of Letters Patent No. 765,057, dated July 12, 1904.

Application filed May 5, 1903. Serial No. 155,720. (No model.)

To all whom it may concern:

Be it known that I, MAURICE WEHRLIN, engineer, a citizen of the Republic of France, residing at 74 Rue de la Victoire, Paris, in the Republic of France, have invented certain new and useful Improvements in Apparatus Operated by a Perforated Band for Casting Spaces, of which the following is a specification.

This invention relates to improvements in machines for casting and composing movable type of the kind described in the English Patent No. 18,542, of 1900.

It has for its object to simplify the device for the making of spaces to justify automatically the lines.

The device described in the above-mentioned patent gives rise in practice to some objections which appear in the composed lines which are over the normal length. In such case the unities of correction provided for theoretically for the negative justification—that is to say, fifty tenths of a millimeter—can only be used to a very limited extent. If, for instance, a line has got but few spaces, and if the negative correction of justification is rather strong, the said spaces will become so narrow that their width will not suffice to produce between the words when printed separations clear enough to see. Furthermore, the casting and finishing of very narrow spaces may interfere with the proper working of the machine. The advantage of as much latitude as possible for correction becomes still more apparent when it is required to deal with very strong bodies, (ten to twelve points,) as the larger type then require in the cutting of the words at the end of the lines a larger margin for the justification. The device described in the above-mentioned patent has another disadvantage in that there may be many failures in the numerous contacts which it comprises, chiefly in those corresponding to the row of combinations I shown in the said patent in Figs. 3, 4, 5, 6, and also in the contacts 60, 61, Fig. 2. Such failures have a great effect on the accuracy of the justification. Moreover, in the present patent and for such lines as possess more than the expected number of spaces to receive the unities of justification dealt out there is provided a remedy by compensating automatically the great differences of thicknesses which might occur between the spaces corrected exclusively in the positive sense, on the one hand, and the spaces which are outside the reach of the justification, on the other hand. The current-conducting devices and those which made the electric connections have for the greater part been done away with, and, as far as was necessary, they have been replaced by devices which act mechanically. As in the hereinbefore-mentioned patent, the rows of combinations of holes I II IV are used to move the lines up and to determine the thicknesses of the spaces of justification. However, the meaning of the rows of combinations of holes I II, Fig. 1, is modified.

The characteristic difference in the results obtained by the former machine, on the one hand, and by the machine embodying the present invention, on the other hand, may be summed up as follows: We will now take for the unit of the length the small length chosen for the unit of correction—for example 0.1 millimeter. Let L be the length of a justified line, $a\ b\ c\ d$ the lengths of the words and signs separated by the spaces, e the normal or provisional thickness of the spaces, N the number of spaces separating (N + 1) words of the line, and E the difference of length beginning by the justification, we have

$$E = L - (a + b + c + d + \ldots + N\ e).$$

Practically E is considered as a whole number—*i. e.*, one neglects a fraction of unit of correction. In the patent mentioned the difference E could be positive or negative and was divided out over a number of spaces which was equal to N when the number of spaces was under a certain number P or extent of the justification, (ten to fix the ideas.) The dividing out was only done over P spaces when N

was over P. These two modes of distributing the corrections corresponded to the following formulas (1) and (2): In the case of $N \leqslant P$

(1) $E = N\,k + p\,(\pm 1)$, or
$= (N - P)\,k + p\,(k \pm 1)$,

k and p being entire numbers and capable of being considered, respectively, as the quotient and the remainder (over and under) of the division of E by N. The result was that the corrections of the thickness e of the spaces comprised $(N - p)$ corrections equal to k and p corrections equal to $(k \pm 1)$. The corrections were positive or negative, according to whether E was positive or negative. In the case of $N \geqslant P$,

(2) $E = (P - p)\,k + p\,(k \pm 1)$.

The corrected spaces then comprised $(P - p)$ spaces having a thickness $e \pm k$; p, spaces having a thickness $e \pm (k \pm 1)$, and $N - P$ spaces having a thickness e. The machine thus supplied three kinds of spaces, and it might happen that $e - k$ or $e\,(k + 1)$ were very small. In the present invention the difference E is always positive. It is still divided out in two ways, according to whether N is under or over P, and these two ways correspond to the following formulas (3) and (4): In the case of $N \leqslant P$

(3) $E = N\,k + p$, or
$= (N - p)\,k + p\,(K + 1)$.

According to this formula use is made of $(N - p)$ spaces corrected positively from k and of p spaces corrected positively from $(k + 1.)$ In the case of $N \geqslant P$

(4) $E = (P - p)\,k + p\,(k + 1) + (N - P)\,q$.

q designating a constant quantity positive. Use is then made of $(P - p)$ corrections equal to k, p corrections equal to $(k + 1)$, and $(N - P)$ corrections equal to q, all these corrections being positive. Therefore, we can now dispose of four kinds of spaces having as thicknesses e, $(e + k)$, $(e + k + 1)$, $(e + q)$, and we can thus avoid the use of spaces too thin or too different one from another. Whatever the justification may be there will be sufficiently wide intervals between the words, and the composition will have a regular appearance.

We will now proceed to show how the new arrangement of the justification apparatus, although using a less number of longitudinal lines of perforations in the registering-band, allows of giving to each space a greater correction than with the former apparatus, and, in fact, in the previous machine there was used a band having seven lines of perforations, and in the rows designated by I II, corresponding, respectively, to p and to k, the lines had the following significations:

Lines.	Row II.	Row I.
7	+	+
6	−	−
1	1 unity of correction.	1 space.
2	2 unities of correction.	2 spaces.
3	3 unities of correction.	3 spaces.
4	4 unities of correction.	4 spaces.
5	10 unities of correction.	5 spaces.

The value of k was constituted by the sum of the values corresponding to a certain number of holes of the row II and could at its highest point go up to $1 + 2 + 3 + 4 + 10 = 20$. At its highest point the value of the correction of a space e could consequently go up to $20 + 1 = 21$ unities. The value of p was determined by a single hole of the row I and could go up to five.

In the present machine there is still used a band of seven lines; but only five lines are used for the requirements of the process of justification according to the present invention. The lines 6 and 7 thus remain idle as to justification, but will find their application in other functions, which do not concern the present invention. The lines 1 to 5 have the following significations:

Lines.	Row II.	Row I.
1	1 unity of correction.	1 space.
2	2 unities of correction.	2 spaces.
3	3 unities of correction.	3 spaces.
4	4 unities of correction.	4 spaces.
5	11 unities of correction.	11 unities of correction.

By means of a suitable arrangement of the electric connections the hole 5 of the row I can be used so as to coöperate with the holes of the row II in the function of determining the correction k. At its highest point the value of k can go up to $1 + 2 + 3 + 4 + 11 + 11 = 32$. The highest value of the correction brought to e is consequently $32 + 1 = 33$ unities—that is to say, twelve unities more than in the previous case. On the other hand, the row I can comprise several holes, so that the value of p can go up to $1 + 2 + 3 + 4 = 10$ spaces. Being given that a unity of justification is 0.1 millimeter, the new apparatus allows of obtaining the subjointed highest widening of a line which might have only three spaces, which is the most unfavorable case. In this case the increase attributed to each space by the row II would be thirty-two unities, for the three spaces, taken altogether, 32×3. Furthermore, the row I would supply three unities—viz., one to each space. The total widening of the line would be $32 \times 3 + 3 = 99$ unities, or 9.9 millimeters. Such is the latitude which can be completely disposed of for the cutting of the words at the end of each line. In the former apparatus, on the contrary, the latitude of one hundred unities or ten millimeters provided for the cutting of the words at the end of the lines

was only fictive, and, in fact, it admitted of fifty unities for the negative correction and fifty unities for the correction positive. Well, now, if the latter fifty unities could be entirely used, that was not always the case for the former fifty unities. If it had been necessary, for instance, to make a rather large correction negative—say forty-five unities—and if the line had only three spaces, each space would have been diminished by fifteen unities, and as *e* equals fifteen unities the spaces would have been reduced to 15 — 15 = 0. Without reaching this extreme extent it frequently happened that the spaces were reduced to such a narrowness that their casting and finishing by the casting-machine became impossible, as hereinbefore stated. In the preparation of the band it was necessary for the purpose of avoiding these inconveniences to only use a part of the theoretical latitude provided for for the cuttings at the end of the lines. Besides this increase in the extent of correction, which has just been set forth, the present invention insures a great simplification of the mechanism, serving to set the position of the mold-drawer for producing each space in register with the sum of the corrections registered on the band, and, in fact, instead of an algebraical summation only an arithmetical summation is required, and the mechanical arrangements relating to the subtractive corrections, as well as the commutators implied by the changes of signs can thus be dispensed with. It will be seen by the subjoined specification this essential and primary simplification of the structure leads to other simplifications, which are secondary. As to the obtaining of the correction *q* on the spaces beyond the tenth, that does not lead to any complication of the electrical part, but only a slight modification of the mechanical part.

The mechanical arrangements of the apparatus are shown in the accompanying drawings, in which—

Figure 1 represents a part of the registering-band, which has special relation to the functions of the present invention. Fig. 2 represents the electrical wiring relating to the function of the hole 5 of the row I. Fig. 3 is a front elevation of the justification-wheel 51, with the arrangement for automatically operating the same. Fig. 4 is a side elevation corresponding to Fig. 3. Fig. 5 shows the steps of the justification-wheels 51 53 in the normal position. Fig. 6 is a transversal section of the justification-wheels and shows the electromagnet-fittings. Fig. 7 is a front elevation of the whole plant. Fig. 8 is a top plan view of the justification-wheels, which are shown as being developed and in their normal position.

The perforated band (shown in Fig. 1) is enabled to operate the present mechanism by means of a deciphering apparatus, already described in the previous patent. This apparatus, through the medium of a commutating device composed of the parts 12, 24, $24^{\times}$, and 23, Fig. 2, and which comes into action at the proper time under the influence of the row of holes IV, first causes the removal of the finished line and then determines, through the influence of the rows I and II, the thickness of the spaces of justification. The setting in position of the abutting part intended to bring to a stop the mold-drawer 105 106, Fig. 6, for the purpose of obtaining spaces of justification having the required extent is a result of the motion of the wheels of justification 51 53 58, which is brought about by the action of the rows of holes I II of the registering-band. When the row of holes IV of the band passes under the spring-contacts 1 to 7 of the deciphering apparatus, Fig. 2, a circuit coming from a battery is closed in the machine through the medium of the hole 5, and by well-known means the arm 12 of the commutator is brought successively onto the two series of contacts 24, $24^{\times}$, and 23, respectively, during two revolutions of the shaft of the machine. These movements take place in such a manner that when the row of holes I comes under the spring-contacts 1 to 7 the arm 12 of the commutator lies on the contacts 24 and $24^{\times}$ and remains there until further movement of the registering-band. Such is the action of the holes of the row I that circuits are closed by means of the rotatory brushes 16 17 and the contact-segments corresponding to the same on the distributing-disk 10. Thus, for instance, the hole I of the registering-band will close a circuit through the segments $1^{\times}$ and $1^{\times\times}$ of the distributing-disk as soon as the brushes 16 17 touch these segments. The current from the battery passes through wire 21, the contact-roller 8, the spring-contact 1, the segments $1^{\times}$ and $1^{\times\times}$, the contact-screw $1''$ of the commutator 12, and the contact-plate 24; from thence it passes to the electromagnet $25^{\times\times}$ and the wire 22, back to the battery 20. The armature 150 of the electromagnet $25^{\times\times}$ is pulled and acts on the parts 149 151 to allow the working of the parts 128, 126, 120, 119, 110, and 111, as already known by the previous patent. This movement has the effect of turning the wheel of justification 53 to the extent of one tooth, which corresponds to one unity of justification. So soon as the brushes 16 17 pass onto the contact-segments $3^{\times}$ $3^{\times\times}$ an analogous action is produced. The current passing in the closed circuit again puts in motion the armature of the electromagnet $25^{\times\times}$, on account of which the wheel 53 turns again, but this time to the extent of three teeth, corresponding to three unities. The fifth hole also produces the closing of a circuit; but the current follows a path quite different from the previous ones. Starting from the battery, it passes through the segments $5^{\times}$ $5^{\times\times}$ and the contact-screw $5''$ to the segment $24^{\times}$, which is insulated from the segment 24. From

thence the current passes through the conducting-wire $24^{\times\times}$ to the electromagnet $30^{\times\times}$ and the conducting-wire 22, back to the negative pole of the battery. The polarization of the electromagnet $30^{\times\times}$ produces a rotation of the wheel 58, Fig. 6, in the same way as that mentioned for the wheel 53; but in this case the wheel turns to the extent of eleven teeth, because the projection 115 of the cam 110, Fig. 7, which begins to operate synchronically with the making of this circuit, imparts at the very moment to the pawl-carrying yoke 126 a rotatory movement corresponding to eleven unities. The row of perforations II, passing under the deciphering apparatus after the arm 12 of the commutator has come onto the plate 23, has the effect of closing the circuits corresponding to the existing holes 1 3 4 5 of the band. The currents, passing also through the brushes 16 17 and the contact-segments (designated by the corresponding numbers) are sent at the proper time into the electromagnet $30^{\times\times}$, so that the justification-wheel 58, Fig. 6, in virtue of the movements of the arc 126 and its pawl mechanism, Fig. 7, turns first to the extent of one tooth, then of three and four, and lastly of eleven teeth for the hole 5. Each tooth still corresponds to one unity of justification. The following row of perforations finds the lever 12 of the commutator gone back again into the position shown in the drawings, which is that corresponding to the deciphering of the letters of the registering-band.

The function of the pawl mechanism, which comprises the parts 151, 139, 128, and 126, is similar to that described in the previous patent, with this difference, however, that in the present patent the yoke 126 only carries two pawl mechanisms, and that only for the justification-wheels 53 and 58.

The arrangement of the justification-wheels one with respect to another has been in the present invention so selected that the wheels 51 and 53 only carry in each case plain steps, the height of which corresponds exactly to one unity of justification. These steps are so located the one with respect to another when the wheels are in their normal position that after the wheel 51 has turned to the extent of one tooth in the direction of the arrow shown in Figs. 3 and 5 the two wheels can be brought nearer the one to the other to the extent of one unity of justification. The wheel 58 is so provided with helical pitches that for each rotation to the extent of one tooth the part abutting against the drawer of the mold 105 106 allows of the widening of the mold—that is to say, of the space—to the extent of one unity. This wheel bears besides against the wheel 98, provided with corresponding helical pitches. The latter carries on its side opposite to the helical pitches gradients arranged in the same manner as those of the wheel 51, but of which the height is 0.4 millimeter, corresponding to four unities of justification. Against these gradients bears the disk $98^{\times}$, also provided with gradients arranged in the same manner as those of the wheel 53, but being 0.4 millimeters high. The wheel 98 is so mounted on the shaft 92 by means of a key $98^{\times\times}$ that it can be moved longitudinally of the shaft, but without being able to turn on the same. A circular snug forming an integral part of the wheel 98 carries the disk $98^{\times}$, which can turn thereon.

The arrangement which is to bring into operation the part 106 abutting against the drawer of the mold when the spaces are being produced is similar to that described in the previous patent. It comprises the parts 78 101 102 103. The device for stopping the justification-wheels 51 53 58, which comprises the pawl 161, Figs. 3, 4, and 7, carried by the lever 158 160, and which at the end of each line is by the action of the row of holes IV of the registering-band moved out of contact with the justification-wheels through the medium of the finger 162, is also known, the same having been described in the previous patent. Likewise the apparatus comprising the parts 164, 165, 166, 168, 169, 170, and 171, Fig. 7, for putting the pawls 161 out of action after the casting of ten spaces of justification is also constructed as described in the said patent; but it has been provided with a particular device which before the casting of each space causes the wheel 51 to turn in the direction of the arrow shown in Figs. 3 and 5 to the extent of one tooth, corresponding to one unity. For that purpose the lever 164 has an arm $164^{\times}$, Figs. 3, 4, and 7, carrying an operating-pawl $164^{\times\times}$, the tooth $164^{\times\times\times}$ of which meshes with the teeth of the wheel 51. As is known by the previous patent, each combination of the registering-band which indicates a space (row III) puts in motion the lever-arm $164^{\times}$ through the medium of the parts 102 and 103. The pawl $164^{\times\times}$, pivoted on the said arm, is then pushed upwardly and causes the wheel 51 to turn for each space to the extent of one tooth. After the casting of a certain number of spaces, the amount of which for each line is designated by the registering holes of the row I, the wheels 51 and 53 come into a position the one with respect to the other in which there is no separation between them. As the pawl $164^{\times\times}$ imparts motion to the wheel 51 before the casting of each space, it is necessary to so arrange the two wheels the one with respect to the other when in their normal postion that the two wheels only come together at the passage of the first combination of space of the line. That is the reason why the steps of these wheels when the latter are in their normal position are in the situation one with respect to the other shown in Fig. 5 and which corresponds to a separation representing one unity of justification for the system of parts abutting against the drawer of the mold taken

altogether. The rows of holes I and II of the registering-band, Fig. 1, will have the effect in the case considered of first turning the wheel 53 to the extent of four teeth, then the wheel 58 to the extent of thirty teeth, the latter wheel having turned under the influence of the hole 5 of the row I and of the holes 1, 3, 4, and 5 of the row II. These two wheels thus widen by thirty-one unities the system of parts abutting against the drawer of the mold 105 106 when taken altogether. If the line has, for instance, five spaces, the movements of the wheels will have the following effect on the production of the spaces: Before the casting of the first space the row of perforations III, which corresponds to a space, has the effect, through the medium of the finger 103 and of the lever 101 102, of placing the piece 78 in position to abut. At the same time the pawl 164^{xx} is so moved that the wheel 51 is turned to the extent of one tooth; but as the wheel 53 has been previously turned four teeth by the action of the row of holes I of the registering-band the movement of the wheel 51 will have no influence at all on the thickness of the abutting device taken altogether, and the space which will then be cast will have a thickness greater than the normal one by thirty-one unities. For the fifth space after the wheel 51 will have turned one tooth for each of the previous spaces the two wheels will be, the one with respect to the other, in such a position that they can be brought nearer together to the extent of one unity. The total thickness of the abutting device for the drawer of the mold will thus be diminished to the extent of one unity, and the fifth space produced will not be more than thirty unities over a normal one. If the line had more than five spaces and less than ten, the rotations of one tooth of the wheel 51 from the sixth tooth, and generally from the tooth for which there is produced the diminution of one unity of correction, to the tenth tooth would no longer have any action on the total thickness of the abutting system, because the wheel 51 has only nine forwarding-teeth, and the steps are so fitted that the wheel 51 can be moved in respect to the wheel 53 and in the direction of the arrow beyond the initial position of no separation to the extent allowed by the said nine teeth without changing for that the total thickness of the abutting system. It may even happen that there is no separation of the disks 51 53 from the very first tooth. Such is the case for a line in which the total correction can be exactly divided by the number of spaces. Then the wheel 53 is not used for the justification. In this case the position of no separation occurs when the first space is cast and is maintained up to the end of the line, even if it comprises as many as ten spaces, regardless of the fact that the wheel 51 is still turned one tooth at each space. In the lines which have more than ten spaces it might occur that the justification requires for each space a correction of more than eight or nine unities, and then there would be a great difference of thickness between, on the one hand, the ten first spaces, the only ones between which, according to the method revealed by the previous patent, the justification correction should be dealt out, and, on the other hand, the spaces beyond the tenth one, which would be of the normal size. The composition would then have a defective appearance, because a part of each line would seem to be closer than the other part. According to the present invention this defective appearance of the composition is avoided by adding automatically by means of a mechanical device a number q of unities—for instance, five unities at the eleventh and following spaces in any line having more than ten—so that these last spaces are obtained with a thickness which is five unities of justification greater than the normal one. Of course these corrections of five unities are taken into account when the band is perforated to suitably determine the holes in the rows I and II. As in practice in the greater number of cases the number of unities of justification to be dealt out is about one-half the total number of unities which can be disposed of, the result will be that the ten first spaces which receive the correction of justification will usually differ but very little from the following spaces obtained by the present invention, so that all the spaces of the line will appear equal to the eye. The mechanical plant used to obtain this result comprises the steps of the wheel 98 and of the disk 98^{x}. The latter is connected with the pawl-carrying lever 158 160, Fig. 7, by means of a link 98^{xxx}. The action of these parts on the abutting system is as follows: When for the eleventh space the lever 160 moves toward the left to remove the retaining-pawls from the wheels, the link 98^{xxx} imparts to the disk 98^{x} a certain rotation. The result is that the steps of the disk 98^{x} and those of the wheel 98 increase by four unities the total abutting system for the drawer of the mold 105; but as on account of the movement of the lever 160 the pawls 161 move away from the justification-wheels the latter move back into their initial position, and thus act, seeing what the position of the wheels 51 and 53 is the one in respect to the other, to widen by 0.1 millimeter the abutting apparatus generally. The result is that the spaces following the tenth one are widened to the extent of 0.5 millimeter. For all the spaces beyond the tenth one the moving back to the left of the lever 160 is repeated each time before the casting of a space, so that the pawl 164^{xx} can no longer have any action on the wheel 51 after the tenth space, and the disk 98^{x} is moved forward again each time, producing the positive correction of 0.5 millimeter on the following spaces up to the end of the line. At the end

of each line as soon as the finger 162 is moved by the passage of the row of perforations IV of the registering-band the lever 160 is brought back to the right by well-known means to again coöperate in the obtaining of the first spaces of the following line up to the tenth one, and the disk $98^{\times}$ takes again and keeps the position corresponding to the normal thickness of the spaces.

I claim—

1. In a machine of the class described, the combination of a commutator, contacts on said commutator, a contact-segment adapted to be rubbed by certain of said contacts, a second contact-segment so arranged as to be rubbed by certain of said contacts, a third contact-segment adapted to be rubbed by all of said contacts, an electromagnet connected to the first-mentioned segment, an electromagnet connected to the second and third mentioned segments, disks controlled by said electromagnets, a space-casting mold, and means for regulating the width of the mold according to the positions of said disks.

2. In a machine of the class described, the combination of a toothed disk, a pawl engaging said disk, a second disk, a mold for the casting of spaces, means for regulating the width of said mold according to the position of said disks, and a connection between the pawl and said means, whereby the pawl acts upon the first-mentioned disk each time the said means begin to operate.

3. In a machine of the class described, the combination of a plurality of toothed disks, a perforated band, means controlled by perforations of the band which correspond to the beginning of each line for turning one of said disks, means controlled by a perforation of the band which corresponds to each space, for turning a second of said disks, a mold for the casting of the spaces, and means for regulating the width of the mold according to the positions of the disks.

4. In a machine of the class described, the combination of a disk revoluble in one direction, a second disk, means for oscillating the latter after a predetermined number of spaces have been cast, a mold for casting spaces, and means between the disks and the mold for controlling the latter.

5. In a machine of the class described, the combination of a disk always oriented in one direction, a rotary disk, means for oscillating the latter after a predetermined number of spaces have been cast, a mold for casting the spaces, and means for regulating the width of the mold according to the positions of said disks.

6. In a machine of the class described, the combination of a plurality of rotary disks each having a level face, projections formed on another face of each of said disks, means for independently rotating the above-mentioned disks, and an additional disk always oriented in one direction and having inclined steps on one face and uniform steps on the other face, all of said disks being placed in juxtaposition to form an abutting piece of variable thickness.

7. In a machine of the class described, the combination of two rotary disks, each having a level face, uniform steps on another face of each of said disks, a rotary disk having a level face and inclined steps on another face, a rotary disk having a level face, and uniform steps on another face, means for separately rotating the above-mentioned disks, and a disk always turned in the same direction and having inclined steps on one face and uniform steps on another face, all of said disks being adapted to be placed one against another to form an abutting piece of variable thickness.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

MAURICE WEHRLIN.

Witnesses:
MAURICE ROUX,
AUGUSTUS E. INGRAM.