No. 751,363. PATENTED FEB. 2, 1904.

J. D. WHITE.

PRINTING TELEGRAPH RECEIVER.

APPLICATION FILED JUNE 19, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

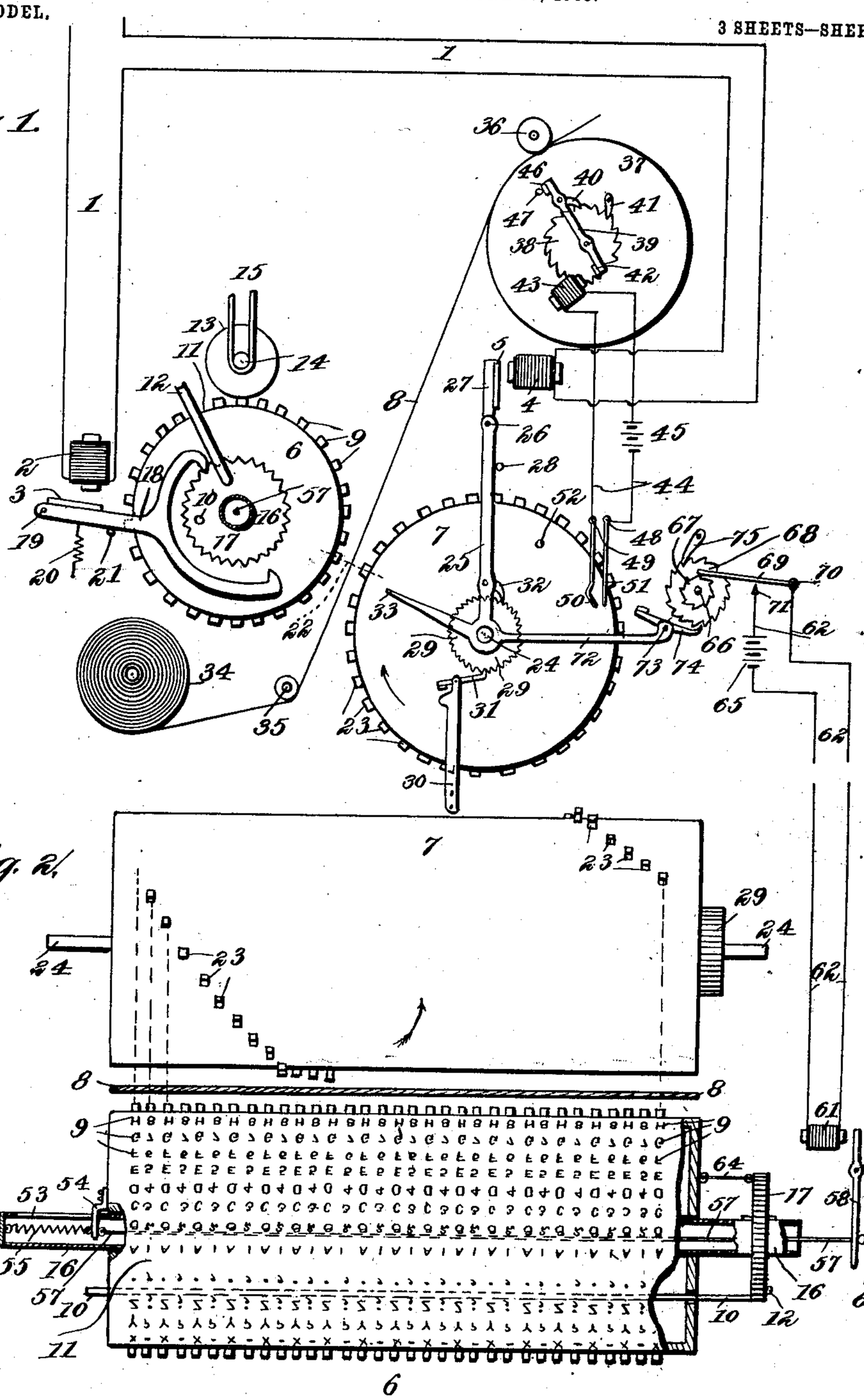

Fig. 2.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 3.

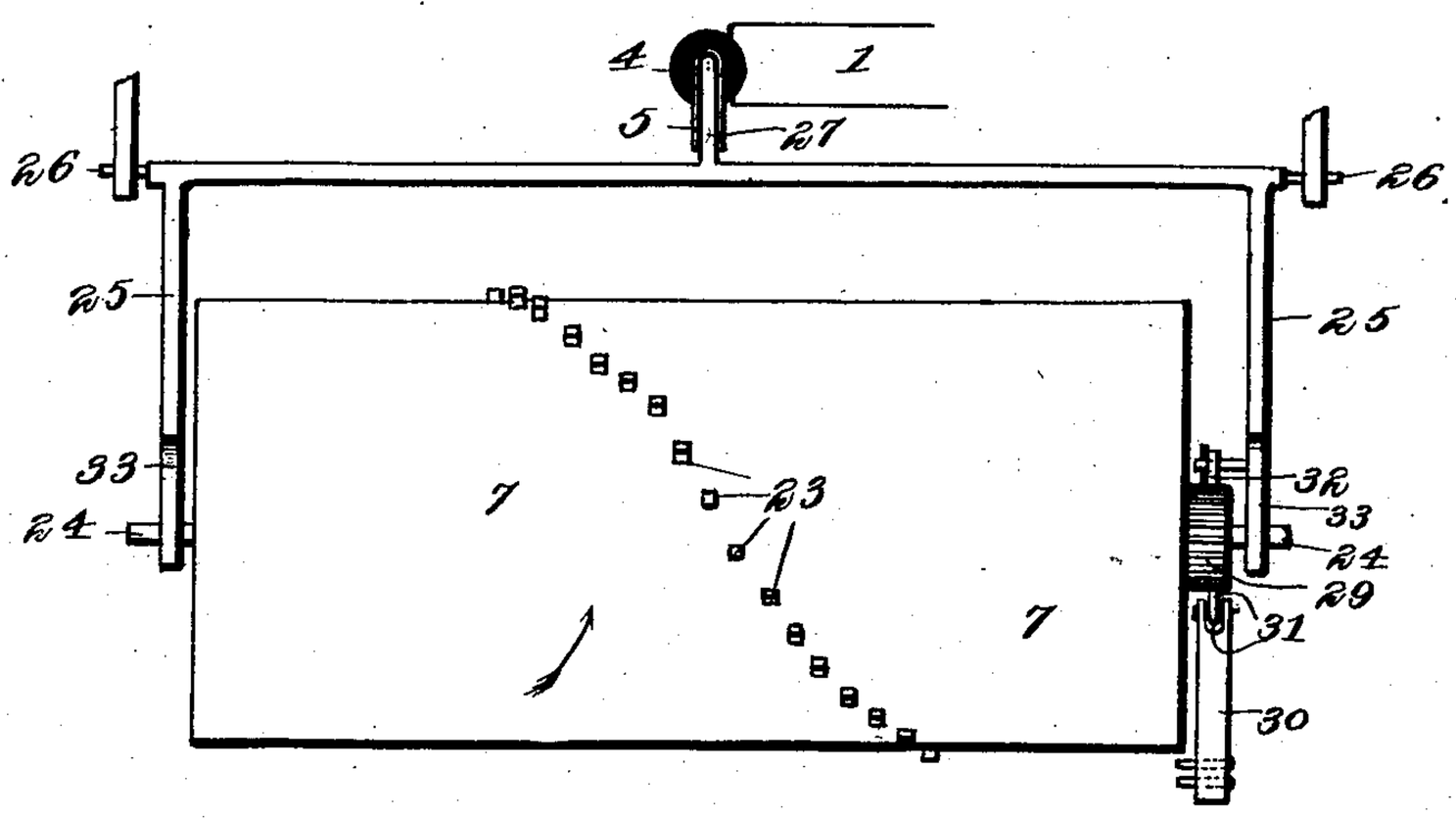

Fig. 1a

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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 4.

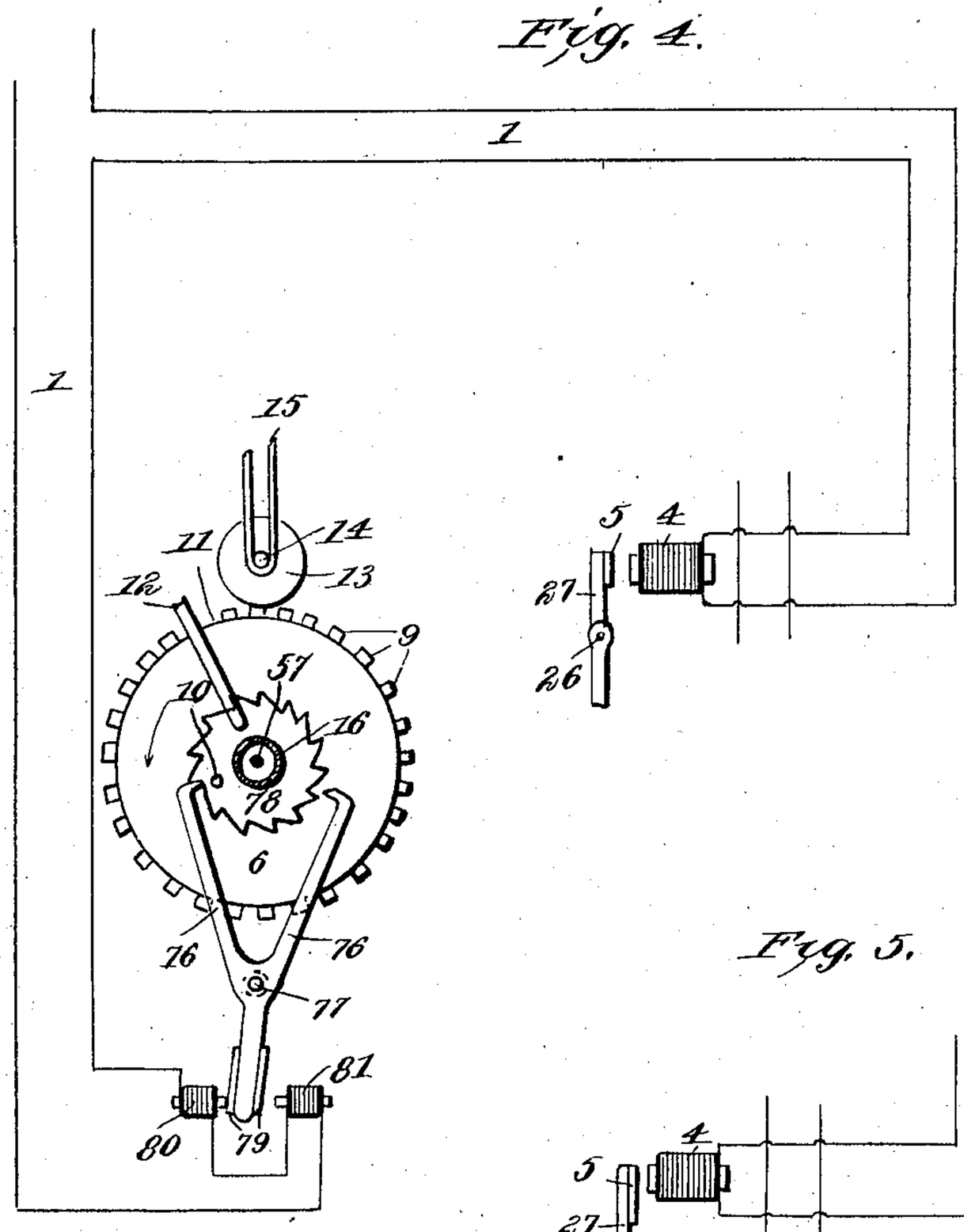
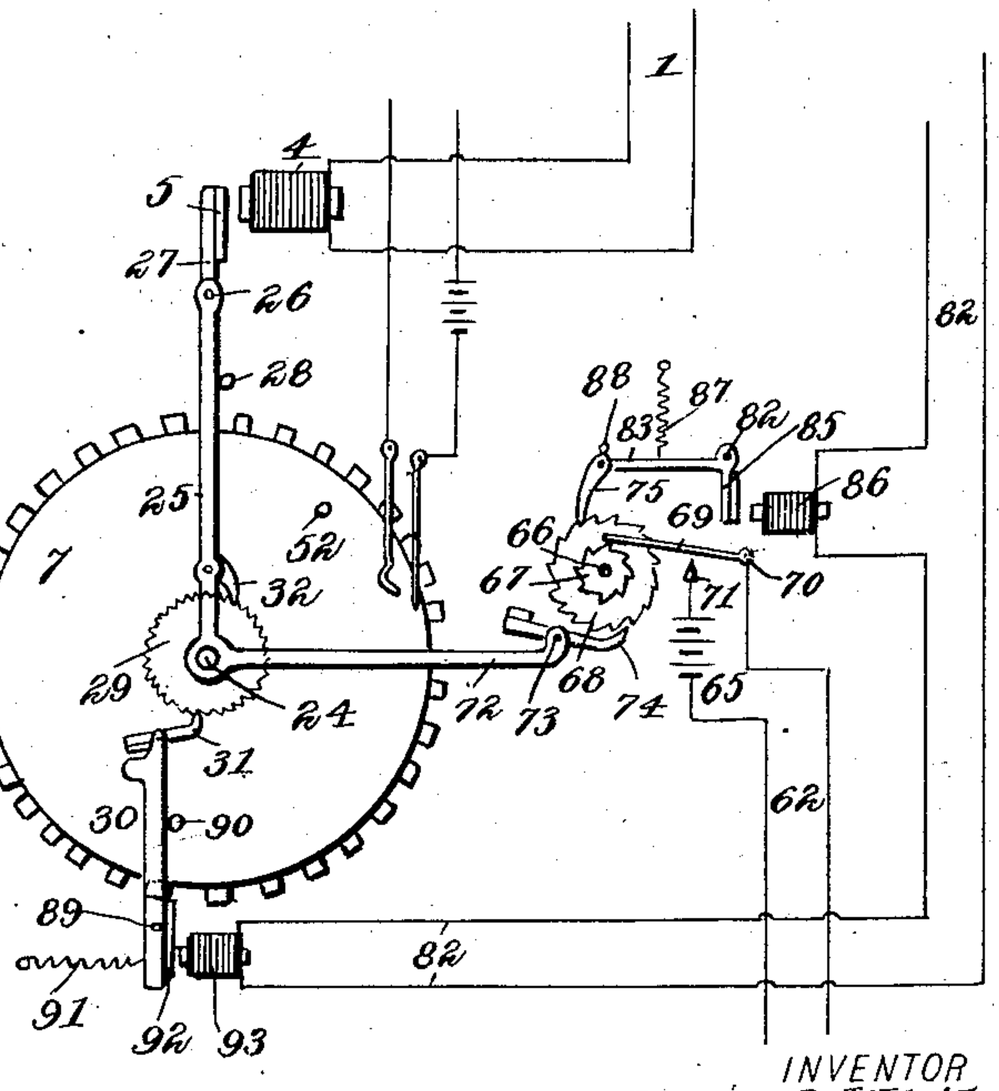


Fig. 5.



WITNESSES:

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No. 751,363. Patented February 2, 1904.

UNITED STATES PATENT OFFICE.

JAMES DUNDAS WHITE, OF LONDON, ENGLAND.

PRINTING-TELEGRAPH RECEIVER.

SPECIFICATION forming part of Letters Patent No. 751,363, dated February 2, 1904.

Application filed June 19, 1903. Serial No. 162,175. (No model.)

To all whom it may concern:

Be it known that I, JAMES DUNDAS WHITE, a British subject, residing at 50 Clanricarde Gardens, London, England, have invented new and useful Improvements in Printing-Telegraph Receivers, of which the following is a specification.

My improvements relate to printing-telegraph receivers which print the characters in lines across the paper and are so contrived that in each line of print the characters are printed successively from left to right across the paper without corresponding lateral movement of the type or converse lateral movement of the paper, the paper being only moved up at the end of each line, so as to be ready for the next line. A simple form of such a printing-telegraph receiver is described in my patent of the United States for improvements in printing-telegraph receivers, No. 743,122, dated November 3, 1903.

The objects of my present invention are to provide a printing-telegraph receiver of the same general character as that other, but so contrived that as compared with that other the range of characters is doubled without the amount of the step-by-step movement being increased, so that the same amount of step-by-step movement, which in that other case is utilized to give a certain range of characters (which may be called "letters") is in this case utilized to give that same range of characters of one class (which may be called "letters") and also a similar range of characters of another class (which may be called "figures") and also to provide suitable means for printing from either class continuously and for shifting from either to the other at will.

The printing-telegraph receiver which forms the subject-matter of this application differs in various ways from that which is described in the specification referred to and will best be described by independent description. For simplicity I shall describe the mechanism as operated by an electro-mechanical device by which the rotation of the type-cylinder is effected by currents of one polarity sent along a single wire, while the other cylinder is operated by currents of the other polarity sent along the same wire; but I do not limit the operation of the invention to this particular device. It may also be operated by any of the electromechanical devices used to rotate type-wheels and to effect printing, and variations illustrating how some of these may be applied to it are also shown.

I attain the objects of my present invention by the mechanism and electromechanism shown in the accompanying drawings, in which—

Figure 1 is a diagrammatic side view of the apparatus. Fig. 1ª is a detail in side view of one end of the inking-cylinder. Fig. 2 is a view from above of the type-cylinder and the hammer-cylinder with the paper between them and of certain other fittings. Fig. 3 is a view of the rocking frame and the hammer-cylinder as seen from the side adjacent to the type-cylinder, and Figs. 4 and 5 show details of modifications.

A certain circuit in Fig. 1 is shown extended to alined contiguity to the corresponding portion in Fig. 2 in order to illustrate the coaction of the combined devices, whereby the momentum of one moving part (shown in Fig. 1) is utilized for the movement of another moving part, (shown in Fig. 2,) which latter part moves in a different plane and requires more motive power than the actual momentum of the former moving part would supply.

1 is the main wire, along which currents of either polarity may be sent from an ordinary transmitter. In this circuit is the electromagnet 2, which attracts the armature 3, and the electromagnet 4, which attracts the armature 5. The armatures are so magnetized and set and the electromagnets so wound that a current of one polarity, (which I shall call the "positive" current,) causes the electromagnet 2 to attract the armature 3, but does not cause the electromagnet 4 to attract the armature 5, while a current of the other polarity (which I shall call the "negative" current) causes the electromagnet 4 to attract the armature 5, but does not cause the electromagnet 2 to attract the armature 3. These two electromechanical devices operate, respectively, the type-cylinder 6 and the hammer-cylinder 7, between which is arranged the paper 8.

The type-cylinder 6, which is preferably a

hollow cylinder of light metal, has along its surface a succession of longitudinal rows of type 9 9. Each row has two different characters repeated alternately on a straight line and which I shall call, respectively, "letters" and "figures," using the term "letters" (in accordance with the drawings) to include the letters and the full stop and the term "figures" (in the same way) to include the figures, fractions, and various marks of punctuation. Each longitudinal row has different characters from every other row progressing in regular alphabetical and numerical order around the cylinder. Every row has the same number of characters and that number exceeds by one the number of letter-spaces which it is proposed to have in the line of print. In the drawings the number of characters in each row is thirty-three. These rows of type are parallel to the axis of the cylinder and they are placed round it one beside another, so that the general effect resembles that of a series of letter-wheels and figure-wheels alternating with one another along the same axis, all the letter-wheels being similarly set and all the figure-wheels being similarly set, so that one letter and one figure alternate through each row. These longitudinal rows of characters may be of any convenient number. In the drawings they are represented as twenty-eight, of which twenty-seven are occupied by characters, (letters and figures,) while the remaining one, (marked 11,) which corresponds to spacing, is blank. From the toothed wheel (presently to be described) at the end of the cylinder opposite the end of that blank line projects an arm which is bent round, as shown at 12, the bent part being sufficiently far out to allow it as the cylinder is revolved to pass clear of the hammer-cylinder 7 of the paper 8 and of the inking-cylinder 13, which latter is kept in position by its axle 14 being in the slotted frame 15 and which inking-cylinder rests on the type-cylinder 6, inking it as it revolves. This inking-cylinder is fitted so that it can slide along its axis sufficiently to allow of its being slid by the pressure between it and the type-cylinder 6 when the latter is reciprocated longitudinally, as will be presently described.

The type-cylinder 6 is set on a hollow axle 16, at one end of which is the toothed wheel 17, from which projects at right angles the arm 10, which passes through the cylinder in such a way that the cylinder revolves with the toothed wheel, but may be reciprocated backward and forward along the axle 16, as hereinafter described. The toothed wheel 17 is actuated by the "push-and-pull" bifurcated lever 18, pivoted at 19 and having attached to it the armature 3. The two arms of this lever engage alternately the toothed wheel from opposite sides. As often as the electromagnet 2 attracts the armature the lever is pulled up, and as often as the magnet ceases to operate the spring 20 causes the lever to return to the stop 21. Thus as often as the circuit 1 is closed by a positive current and opened again the arms of the lever alternately act upon the wheel. The proportions of the parts are such that successive movements of this kind bring the successive rows of type 9 9 successively to the position indicated by the dotted line 22, which I shall call the "printing-level." By this step-by-step mechanism successive positive impulses serve to bring the required rows of characters to the printing-level.

The hammer-cylinder 7 is a light cylinder of about the same length as the other, having around it, arranged as a single-turn spiral, a series of projections 23 23, which I shall call the "hammers" or "impact-faces" and which are of the same number as the number of letter-spaces which it is proposed to have in the line of print. In the drawings they are represented as thirty-two. These hammers while set spirally round the hammer-cylinder are so set that each is in line with one of the circular series of characters on the type-cylinder and that the hammers on the one cylinder are approximately of the same length and breadth as the characters on the other. The circular series on the type-cylinder, as already said, are in number more by one than the number of letter-spaces which it is proposed to have in the line of print and are thus more by one than the number of the hammers on the hammer-cylinder. Hence there will be one series which has no hammer in line with it. This "excess" series will be the series on the extreme right or the series on the extreme left, according as the type-cylinder has been slid to the right or to the left, as will be considered presently.

The hammer-cylinder 7 is on the axle 24, journaled in the rocking frame 25, which latter is pivoted at 26 about a stationary center and has above it the rigid extension 27, on which is located the armature 5. The general arrangement is such that as often as a negative current is sent along the line 1 the electromagnet 4 attracts the armature 5, so that the frame 25, carrying the hammer or impact-cylinder 7, is rocked about the center 26 toward the type-cylinder 6, the paper 8 being between them. The parts of the cylinders which thus come into contact are of the hammer-cylinder, the impact-face, which is at the printing-level, and of the type-cylinder, the opposite character of the row which is at that time at the printing-level. The rocking parts fall back when the current ceases, and the stop 28 prevents them falling back too far. Besides this rocking movement the cylinder 7 has a rotary movement on its axis, which is effected as follows: On the end of the cylinder is the ratchet 29, which has as many teeth as there are impact-faces on the cylinder. The stationary upright 30 carries a pawl 31, which

engages the teeth of this ratchet, the proportions being such that when the hammer-cylinder falls back after each stroke the ratchet 29 (which is kept from reversing by the detent-pawl 32) is caught by the pawl 31 and moved round the space of one tooth, so that the impact-face which was at the printing-level is moved on and the face next below it is brought to the printing-level, ready for the next stroke. From the arrangement of the impact-faces it will be seen that this next face, besides being below the other, is on the right side of it, with the general result that as stroke after stroke is made the printing passes along from left to right (as viewed from where the type-cylinder is) and the last impact-face on the right is followed by the first on the left, thus beginning a new line. Thus the printing in the manner described is effected by negative currents through the wire 1, while the nature of the characters printed is determined by the position of the type-cylinder 6, which is controlled by positive currents along the same wire.

The following arrangements are made for spacing: From the rocking frame 25 projects the arm 33, which moves with it, but does not effect anything except when the frame 25 is rocked toward the type-cylinder 6 and the blank row 11 is at the printing-level. When that happens, the projecting arm 33 comes against the projecting arm 12, and the proportions are such that this prevents the frame 25 and the hammer-cylinder 7 from going as far as they otherwise would, but still allows them to go far enough for the return movement to cause the ratchet 29 to be caught and turned the space of a single tooth by the pawl 31, thus revolving the hammer-cylinder as if a character had been struck and causing spacing without printing. Before a new line of print is begun the paper must be spaced up for it, and the general arrangement of the paper may now be described. The paper 8, which is of a flexible character, is fed from the roll 34 round the roller 35, thence passes between the type-cylinder 6 and the hammer-cylinder 7, and is held between the small roller 36 and the large roller 37. On the end of the roller 37 is the ratchet 38, actuated by a lever 39 through a pawl 40 and kept from reversing by a detent-pawl 41. On one end of the lever 39 is the armature 42, opposite which is the electromagnet 43 in the circuit 44, in which is the battery 45. As often as this local circuit is closed the electromagnet 43 attracts the armature 42, so that the lever 39 is moved and the pawl 40 sends the ratchet 38 and the attached roller 37 a step round, while as often as the circuit 44 is interrupted the magnet ceases to attract the armature, and the counterpoise 46 causes the lever 39 to return to the stop 47. The proportions are such that each step of the ratchet sends the paper up sufficiently far for a new line of print to be begun.

The arrangements for closing this circuit 44 at the right time are as follows: From the terminals 48 and 49 are suspended two light strips of metal 50 and 51, which are conductors of electricity. Normally they hang just clear of one another; but as often as the projection 52 on the end of the cylinder 7 (which projection is such as not to interfere with the rotation of the cylinder) comes to a certain place in the course of its rotation it encounters the strip 50, which it pushes against the strip 51, thus closing the circuit 44 and spacing up the paper. The projection 52 is so placed as to do this only when the frame 25 and the hammer-cylinder 7 revert to the normal position after the stroke in which the hammer on the extreme right of the cylinder has been at the printing-level, so that the paper is spaced up between that stroke and the next stroke which begins the new line.

If the type-cylinder were not slid longitudinally, successive strokes of the hammer-cylinder would print letters and figures alternately. In order to secure the printing of letters continuously or of figures continuously and to provide for changing from either to the other at will, the following devices are used. It has been said already that the fittings are such that the type-cylinder 6 while revolving with the toothed wheel 17 can be reciprocated backward and forward along the axle 16. This reciprocation is effected as follows: The axle 16 is made hollow, so that a spring can be placed in it and a line or wire led through it. Along it at one end is the longitudinal slot 53, in which slides the projection 54 on the cylinder 6, to which projection is attached on one side the helical spring 55, which lies in the hollow axle 16 and is attached to one extremity of that axle, as shown at 56. To the other side of the projection 54 is attached the line or wire 57, which passes in the other direction through the hollow axle 16 and is led through a hole at the end of the lever 58, on the other side of which lever it terminates in the rounded stop 59, the general arrangement being such that the line can revolve freely in the hole, but that the stop will not draw through it. The lever 58 is pivoted at 60 and has opposite its other end, which acts as an armature, the electromagnet 61 in the circuit 62. When that circuit is closed, the electromagnet attracts the end of the lever which is opposite to it, so as to draw out the line 57, thus moving the cylinder 6 longitudinally in the direction of the lever (to the right as seen in Fig. 2) and extending the spring 55. When the circuit 62 is opened, the attraction ceases, and the spring 55 causes the cylinder to move in the contrary direction, (to the left as seen in Fig. 2.) Thus as the circuit 62 is closed and opened alternately the cylinder 6 is slid to the right and to the left alternately, the movement to the right being restricted by the stop 63, which limits the movement of the lever

58, and the movement to the left being restricted by an anchorage formed by the inextensible line 64, which connects the cylinder 6 with the toothed wheel 17 and which is alternately slack and tight, according to whether the cylinder is in position toward the right or in position toward the left. The various parts are so proportioned that the range of reciprocation of the cylinder 6 is restricted to a distance equal to the distance between the middle of one character and the middle of the next in longitudinal series. Thus, the parts being set opposite one another as described, each longitudinal movement of the cylinder 6 has the effect of shifting letter series and figure series as regards their application to the hammers on the hammer-cylinder 7, bringing letter series opposite the hammers to which figure series were previously opposite and figure series opposite the hammers to which letter series were previously opposite, so that, for instance, when characters are printed in continuous succession and the type-cylinder 6 is slid longitudinally after each printing stroke the same class of characters which was opposite the last-used hammer is brought opposite the next, and thus (by the continuous progression of the hammers combined with the reciprocating movement of the type-cylinder) the characters printed (when no spacings are interposed) are letters continuously or figures continuously, as the case may be.

As already said, the reciprocations of the type-cylinder 6 are effected by the alternate closing and opening of the circuit 62. That circuit, in which is the electric battery 65, is closed and opened alternately as follows: Behind the hammer-cylinder 7 and journaled at 66 is the ratchet-wheel 67, attached to which and revolving with it on the same axis is the ratchet-wheel 68, which has twice as many ratchets as the ratchet-wheel 67. On the ratchet-wheel 67 rests one end of a light metal strip 69, which is a conductor of electricity and which is pivoted at 70, where it is connected with one terminal of the circuit 62, the other terminal of that circuit being the projection 71, on which the strip 69 falls and from which the strip 69 is raised at alternate intervals, the successive steps of the ratchet-wheel 68 operating the ratchet-wheel 67, so that the successive ratchets of the ratchet-wheel 67 (which are in number half those of the ratchet-wheel 68) alternately rise beneath and pass beyond the strip 69. The proportions are such that as the ratchet-wheel 68 is moved round by successive steps the ratchet-wheel 67 by its effect on the strip 69 alternately opens and closes the circuit 62 at the point 71. The ratchet-wheel 68 is actuated by the following device: On the back of the rocking frame 25 is the projecting arm 72, at the end of which and pivoted at 73 is the pawl 74, which as often as the frame 25 is rocked far enough catches on the tooth of the ratchet-wheel 68 next to the tooth on which it was before, so that the falling back of the frame 25 sends the ratchet-wheel 68 (which is kept from reversing by the detent-pawl 75) one step round. The proportions of the various parts are such that the pawl 74 catches on a fresh tooth as often as the frame 25 is rocked far enough to effect printing, but is not moved far enough so to catch when spacing only is effected—that is to say, when the movement of the rocking frame 25 is restricted by the projecting arm 33 coming into contact with the projecting arm 12.

It has already been said that either the full printing movement of the frame 25 or the restricted movement of it just referred to is sufficient to send the ratchet-wheel 29 and the hammer-cylinder 7 one step round, while from what has just been said it will be seen that the full printing movement is sufficient also to send the ratchet-wheel 68 one step round, (thus sliding the type-cylinder 6 in the direction opposite to that in which it was slid the time before,) while the restricted movement of the frame 25 (which effects spacing) is not sufficient to do this. Thus it will be seen that if a series of characters are struck without any interposed spacing they will be either letters continuously or figures continuously, according to the starting position. If two or any even number of spacings are made successively the effect (besides the spacing) is to make the next following character to be of the same class as the preceding one, and if a single spacing is made or any odd number of spacings are made the effect (besides the spacing) is to make the next following character be of the other class, thus effecting the change from letters to figures or from figures to letters, as the case may be.

I have described this invention as having the type-cylinder operated by currents of one polarity and the hammer-cylinder operated by currents of the opposite polarity along the main circuit; but, as said before, the operation of the parts is not limited to this particular device. They may also be operated by any of the other electromechanical devices which are used in printing-telegraphs for operating the rotation of the type-wheels and for effecting the printing strokes. One of such alternative methods is shown in Fig. 4, in which the axle 16, the ratchet-wheel 78, (which takes the place of the toothed wheel 17 in the other drawing,) and the type-cylinder 6 are caused to rotate in the direction indicated by the arrow by a weight, or by clockwork, or by some other means, while the number of the steps to which they are rotated is governed by the escapement 76, which is pivoted at 77 and engages on the ratchet-wheel 78, which has half as many teeth as the cylinder has longitudinal rows of type, the general arrangement being such that as the teeth of the escapement engage alternately on the ratchets

the rows of type are brought successively to the printing level. The lower end of the escapement is fitted with a magnetized armature 79, which is between the electromagnets 80 and 81 in the circuit 1, the general arrangement being that of a polarized relay of such a character that rapid reversals of polarity in the circuit operate the escapement which controls the step-by-step movement. The electromagnet 4 is made slower in operation than the electromagnets of the polarized relay, so that during the rapid reversals of polarity it is ineffective; but as soon as the reversals cease and the current flows in either direction continuously the electromagnet 4 attracts the armature 5, thus operating the rocking movement with the results already described. In this modification the armature 5 is not magnetized, but is a plain piece of soft iron, and the general arrangement is such that the electromagnet 4, as already said, attracts it whenever the current flows through the circuit in either direction for a sufficient time.

A printing-telegraph receiver of this general description may also be operated by a two-wire system, the arrangements in that case being preferably such that the reciprocation of the type-cylinder 6 along the axle 16 besides being effected by the rocking movement, as described, can also be effected independently of that movement and that spacing without printing can be effected whichever row of type is at the printing level. In this case there need be no blank row on the type-cylinder, and the intercepting-arms 12 and 33 may be eliminated. The other variations for this case are shown in Fig. 5. The movements of the various parts are as previously described; but in addition to the circuit 1 there is another circuit 82, which is used to operate the separate reciprocation of the type-cylinder and to effect spacing by means of the following devices: The detent-pawl 75 (which engages on the ratchet-wheel 68) instead of being pivoted at a fixed point, as shown in Fig. 1, is pivoted on the end of the lever 83 which is journaled at 82 and of which the other end is bent at right angles and carries the magnetized armature 85, opposite which is the electromagnet 86 in the circuit 82, the general arrangement being such that as often as the electromagnet 86 attracts the armature 85 the lever 83 is moved so that the pawl 75 is pressed down and made to send round the ratchet-wheel 68 one step, while when the attraction ceases the spring 87 causes the lever with its armature and pawl to revert to the normal position, the range of movement being restricted by the stop 88. As often as this is done the resulting movement of the ratchet-wheel 67 raises or lets fall (as the case may be) the metal strip 69, so as to open or close the circuit 62 at the point 71, and thus by this means the type-cylinder 6 can be reciprocated independently of the rocking of the frame 25. It may also be operated by that movement, as already described, the ratchet-wheel 68 being in that case operated by the pawl 74. The proportions of the various parts are such that both the pawl 74 and the pawl 75 rotate the ratchet-wheel 68 to the same extent, while from the nature of the arrangement it will be seen that when either of them is returning to its place the other acts as a detent to prevent the ratchet-wheel from reversing. There is also this other device. The part 30, carrying the pawl 31, instead of being fixed rigidly, as shown in Fig. 1, is journaled at 89. Its range of movement is restricted by the stop 90, fixed to some suitable support, (not shown,) against which stop the part 30 is normally kept by the spring 91, and on its lower end is the magnetized armature 92, opposite which is the electromagnet 93 in the circuit 82. The various parts are so proportioned that as often as the electromagnet 93 attracts the armature 92 the arm 30 is oscillated, so that the pawl 31 causes the ratchet-wheel 29 (and so the cylinder 7) to rotate one step, the spring 91 causing the arm 30 and the pawl 31 to revert to the normal position as soon as the attraction ceases. Thus spacing may be effected independently of the printing movement as well as in connection with it, as before described. The armatures 85 and 92 are so magnetized and set and the electromagnets 86 and 93 are so wound that as often as a current of one polarity (which I shall call the "positive" current) is sent through the circuit 82 the electromagnet 86 is caused to attract the armature 85, but the electromagnet 93 is not caused to attract the armature 92, while as often as a current of the opposite polarity (which I shall call the "negative" current) is sent through that circuit the electromagnet 93 is caused to attract the armature 92, but the electromagnet 86 is not caused to attract the armature 85. Thus the sending of a positive current through the circuit 82 slides the type-cylinder, while the sending of a negative current through the same circuit operates spacing, and either of these two movements may be made independently of the other and of what may be called the "principal" movements, which are operated by means of the other circuit, as before described. Taking the first of these supplementary movements alone, it will be seen that the type-cylinder can be reciprocated so as to effect the change from letters to figures or from figures to letters independently of spacing. Taking the second of them alone, it will be seen that spacing can be effected without printing, whichever row of characters is at the printing level. This latter feature avoids the need of revolving the type-cylinder specially for spacing, while the other avoids the need of inserting two or an even number of spaces in order that the character which follows the spacing may be of the same class of the character which preceded

the spacing. Thus, for instance, if by the closing of the circuit 1 a letter has been printed and if a single negative current is then sent through the circuit 82 the result is that that letter is followed by a single spacing. If that negative current through the circuit 82 is not followed by a positive current through that circuit 82, the next following character will be a figure, while if the negative current through the circuit 82 is followed by a positive current through the circuit 82 that positive current will slide the cylinder, so that though there is only one spacing the next following character will be a letter.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. An electromagnetic printing device, comprising a type-cylinder having circularly-arranged series of characters of two kinds disposed around the cylinder with the two kinds alternating in circular series, the alternating characters of the circular series being repeated in rows parallel to the axis of the cylinder, electromagnetic devices for giving both a rotary and a longitudinal movement to said cylinder, a hammer-cylinder arranged parallel to the first-named cylinder and bearing a single row of spirally-arranged impact-faces, and electromagnetic devices for imparting to this cylinder a step-by-step rotary movement, and an integral lateral movement to deliver the printing blow substantially as and for the purpose described.

2. An electromagnetic printing device, comprising a type-cylinder having circularly-arranged series of characters of two kinds disposed around the cylinder with the two kinds alternating in circular series, the alternating characters of the circular series being repeated in rows parallel to the axis of the cylinder, electromagnetic devices for giving both a rotary and a longitudinal movement to said cylinder, a hammer-cylinder arranged parallel to the first-named cylinder and bearing a single row of spirally-arranged impact-faces, electromagnetic actuating devices for this hammer-cylinder, the electromagnetic actuating device for one cylinder being constructed and arranged to be operated by a current of one polarity and that of the other cylinder being constructed and arranged to be operated by a current of the opposite polarity, the sliding of the type-cylinders being effected by a subsidiary device and the hammer-cylinder being arranged to move laterally to deliver the printing blow, substantially as and for the purpose described.

3. An electromagnetic printing device comprising a type-cylinder having circularly-arranged series of characters of two kinds disposed around the cylinder with the two kinds alternating in circular series, the alternating characters of the circular series being repeated in rows parallel to the axis of the cylinder, electromagnetic devices for giving both a rotary and a longitudinal movement to said cylinder, a hammer-cylinder arranged parallel to the first-named cylinder and bearing a single row of spirally-arranged impact-faces, and electromagnetic actuating devices for the hammer-cylinder arranged to give it a step-by-step rotary movement and also an integral lateral movement to deliver the printing blow, substantially as and for the purpose described.

4. An electromagnetic printing device comprising a type-cylinder having circularly-arranged series of characters of two kinds disposed around the cylinder with the two kinds alternating in circular series, the alternating characters of the circular series being repeated in rows parallel to the axis of the cylinder, electromagnetic devices for actuating the cylinder with a step-by-step rotary movement and also a longitudinal character-shifting movement, a hammer-cylinder arranged in movable bearings parallel to the first-named cylinder and bearing a single row of spirally-arranged impact-faces, and electromagnetic actuating devices for both rotating this hammer-cylinder with a step-by-stop movement and also projecting it bodily toward the other cylinder to deliver a printing blow substantially as described.

5. An electromagnetic printing device comprising a longitudinally-sliding type-cylinder having circularly-arranged series of characters of two kinds disposed around the cylinder with the two kinds alternating in circular series and the alternating characters of the circular series being repeated in rows parallel to the axis of the cylinder, electromagnetic devices for rotating this cylinder, a hammer-cylinder arranged in movable bearings parallel to the first-named cylinder and bearing a row of spirally-arranged impact-faces, electromagnetic actuating devices for turning the hammer-cylinder and swinging it bodily and laterally to deliver the printing blow, and an electromagnetic device acted upon by the lateral printing movement of the hammer-cylinder and in turn adjusting longitudinally the type-cylinder, substantially as described.

6. In an electromagnetic printing device, the combination of the type-cylinder bearing two kinds of characters disposed in alternating circular series, a hollow axle carrying the same and having a rigidly-attached ratchet-wheel and connected to the cylinder as described for rigid rotation therewith and a longitudinal sliding motion of the cylinder thereon, a helical spring arranged in the hollow axle and connected to the axle and the cylinder, a central pull-wire attached to the cylinder, a lever attached to the pull-wire and bearing an armature, an electromagnet, battery, circuit and circuit-breaking device, and a laterally-movable hammer-cylinder and mechan-

ism for operating the circuit-breaking device by the lateral movement of the hammer-cylinder, substantially as described.

7. In an electromagnetic printing device, the combination of the type-cylinder bearing two kinds of characters disposed in alternating circular series, a hollow axle carrying the same and having a rigidly-attached ratchet-wheel and connected to the cylinder as described for rigid rotation therewith and also a longitudinal sliding motion of the cylinder thereon, a helical spring arranged in the hollow axle and connected to the axle and cylinder, a central pull-wire extending through the axle and attached to the cylinder, a lever attached to the pull-wire and bearing an armature, an electromagnet and battery-circuit with pivoted circuit-breaking arm, a pair of rigidly-connected ratchet-wheels, one of them having half the number of teeth of the other and working in the plane of and lifting the circuit-breaking arm, a laterally-moving hammer-cylinder having an arm and a pawl acting upon the ratchet-wheel which has the larger number of teeth so as to open and close the circuit alternately with each back-and-forth movement of the hammer-cylinder, substantially as and for the purpose described.

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Witnesses:

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