No. 843,508. PATENTED FEB. 5, 1907.

J. D. WHITE.

PRINTING TELEGRAPH.

APPLICATION FILED JULY 3, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

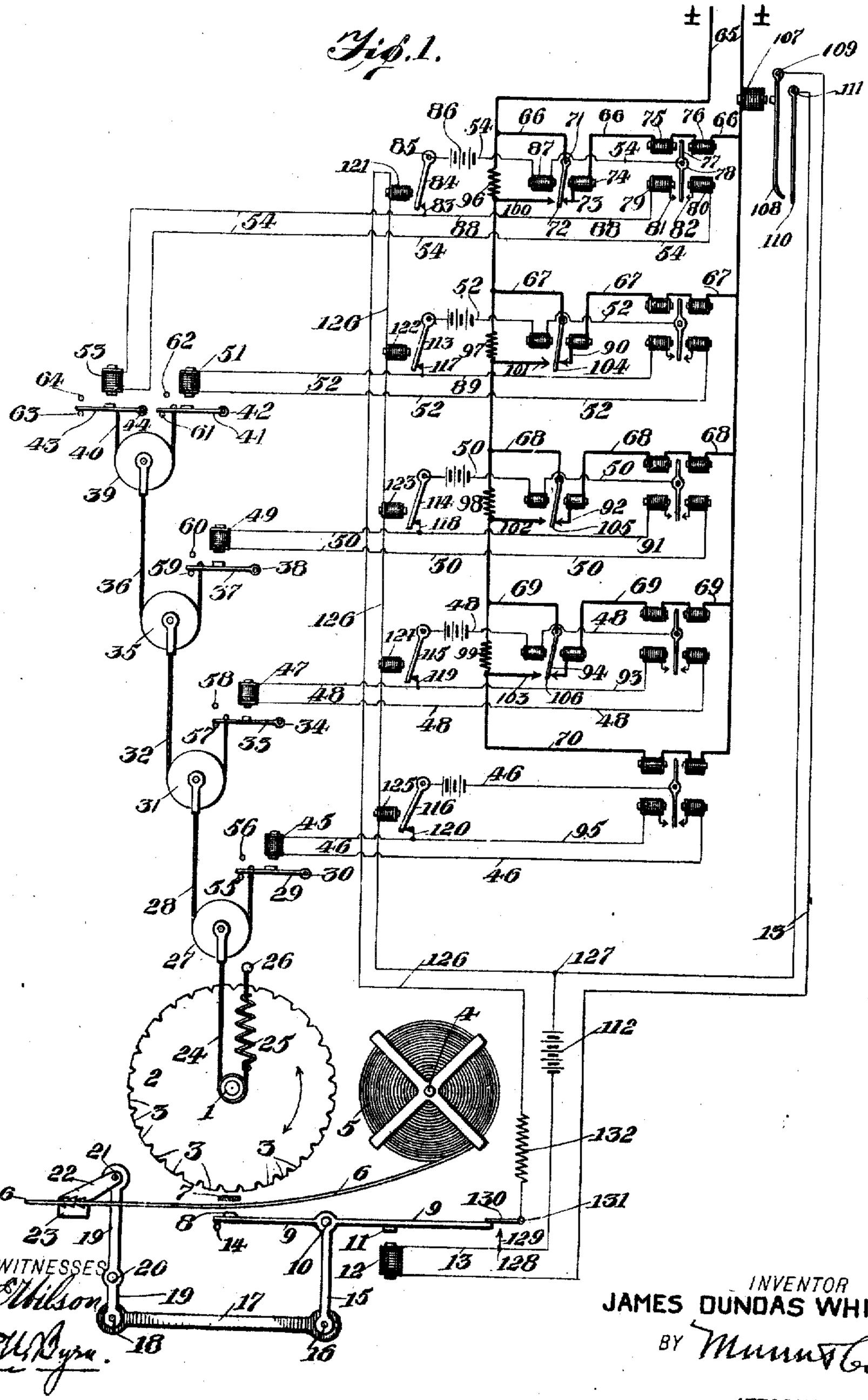

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Fig. 2.

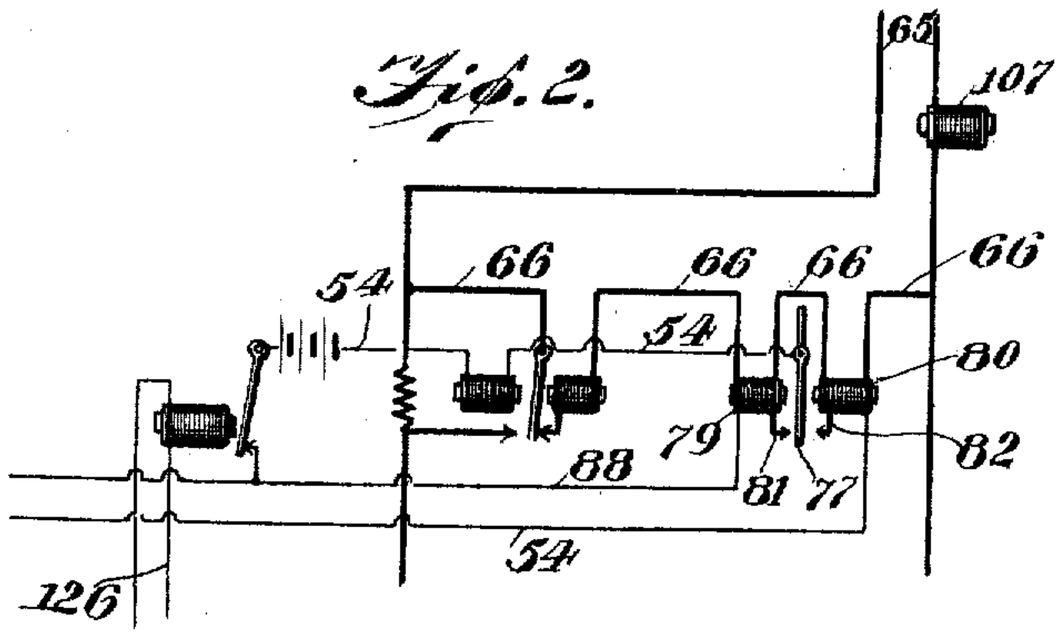


Fig. 3.

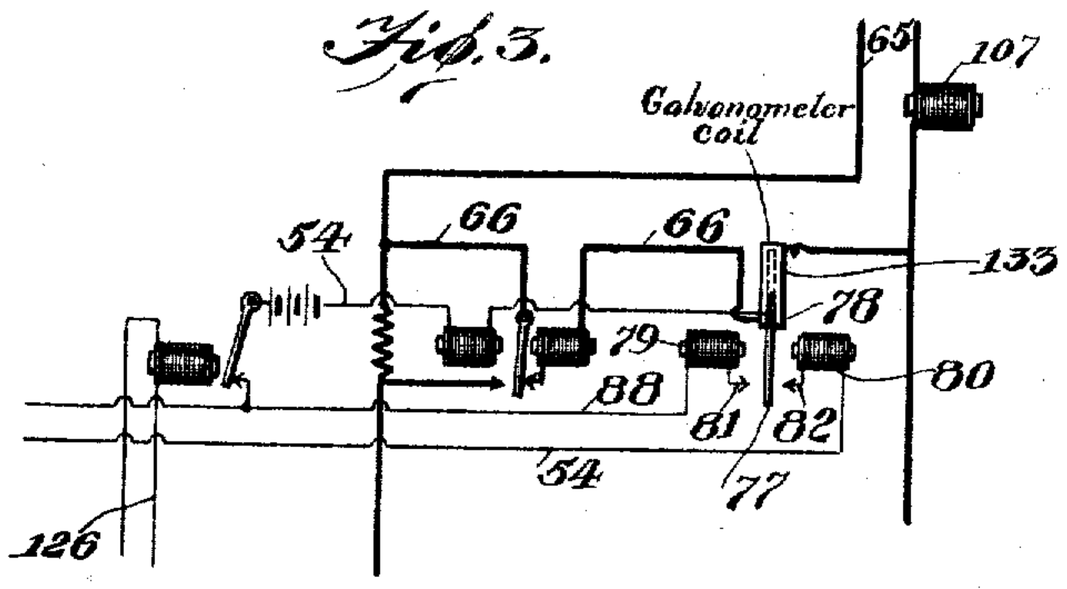
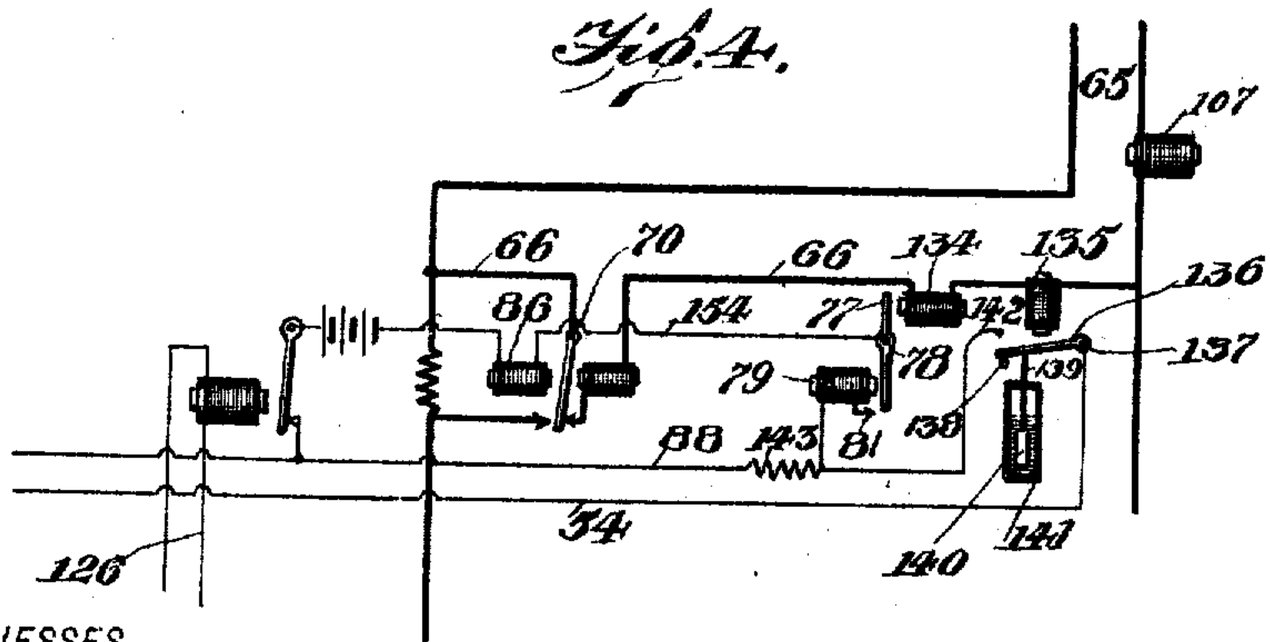


Fig. 4.



WITNESSES
D. C. Wilson.
Edw. W. Byrn.

INVENTOR
JAMES DUNDAS WHITE
BY Munn & Co.
ATTORNEYS

UNITED STATES PATENT OFFICE.

JAMES DUNDAS WHITE, OF LONDON, ENGLAND.

PRINTING-TELEGRAPH.

No. 843,508. Specification of Letters Patent. Patented Feb. 5, 1907.

Application filed July 3, 1906. Serial No. 324,599.

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-Telegraphs, of which the following is a specification.

My invention relates to printing-telegraphs; and the object of my invention is to provide what may be called a "compound selective relay" for use in connection with a printing-telegraph apparatus like that described in the specification of my United States Patent No. 767,322, dated August 9, 1904, so that the various local circuits which control the mechanism may be operated by a main circuit in such a way that messages transmitted along that main circuit from an ordinary Morse or similar transmitter may be printed automatically in the proper characters at the receiving end.

I attain the objects of my invention by means of the mechanism and electromechanism illustrated diagrammatically in the accompanying drawings, in which—

Figure 1 is a diagrammatic side elevation of the apparatus as a whole, showing the compound selective relay in conjunction with the printing-telegraph; and Figs. 2, 3, and 4 are details of modifications

In the drawings, 1 is the axle, on which is set the type-wheel 2, which has thirty-two type-faces 3 3 3. On another axle 4 is the roll 5, from which is gradually unwound the paper fillet 6. Between the fillet and the type-wheel is interposed the printing-ribbon 7, while below the fillet and opposite the lowest type-face is the impact projection 8 (which also acts as a counterpoise) on one end of the lever 9, which is pivoted at 10, and on the other arm of which is the armature 11, opposite which is the electromagnet 12 in the circuit 13, the arrangement being that as often as that circuit is closed the electromagnet 12 attracts the armature 11, thus moving the lever 9 and causing the projection 8 to strike the fillet 6 and the ribbon 7 against the type-face which is then opposite it, thus printing on the fillet the character which is on that type-face. When the circuit 13 is opened, the lever 9 from the weight of the projection 8 reverts to the normal position, as shown, and is kept from going too far by the stop 14. On the lever 9 is also the rigid and downwardly-projecting arm 15, of which the lower end is pivoted at 16 to the connecting-rod 17, of which the other end is pivoted at 18 to the lower end of another lever 19, which is pivoted at 20 and has at 21 on its upper end the pawl 22, which rests above the platen 23, the fillet 6 being between them. Both the pawl and the platen have teeth facing, as shown in the drawings, so that the fillet is moved forward as often as the pawl is moved forward in the direction toward which the teeth point, but is not moved when the pawl is moved backward. The general arrangement is such that the pawl is moved backward when the lever 9 is moved so as to effect printing and is moved forward by the return of that lever to the normal position, so that the paper is intermittently fed forward between the printing strokes.

The fittings thus far described are of a well-known type. I make no claim as regards them, and I describe them only to illustrate the relation with the other parts of a printing-telegraph of my improvements in the means for rotating the axle on which is the type-wheel or type-cylinder.

Round the axle 1 is led with several turns the line 24, which is at one point attached to the axle, so that when the line is drawn one way the axle is caused to rotate in one direction and when the line is drawn the other way the axle is caused to rotate in the other direction. The line 24 is inelastic; but one end of it is attached to the extensible spring 25, of which the other end is made fast at 26, the object of this arrangement being to cause the axle and disk to revolve back again when the contrary tension, presently to be described, is relaxed. That contrary tension is effected thus: The other end of the line 24 is attached to the axis of pulley 27, around which is led the line 28, of which one end is attached to the lever 29, which is pivoted at 30, and the other end to the axis of pulley 31, around which is led the line 32, of which one end is attached to the lever 33, which is pivoted at 34, and the other end to the axis of pulley 35, around which is led the line 36, of which one end is attached to the lever 37, which is pivoted at 38, and the other end to the axis of pulley 39, around which is led the line 40, of which one end is attached to the lever 41, which is pivoted at 42, and the other end to the middle of lever 43, which is pivoted at 44. These five levers are constructed also as armatures, and opposite them, respectively, are the electromagnet 45

in the circuit 46, the electromagnet 47 in the circuit 48, the electromagnet 49 in the circuit 50, the electromagnet 51 in the circuit 52, and the electromagnet 53 in the circuit 54 As often as any one of these five circuits is closed the electromagnet in it attracts the corresponding armature-lever, and thus draws up the line attached to it, and so, though not to the same extent, any lines below that one. The other lines, like the line 24, are inelastic, and the range of movement of the several levers is restricted by stops, one stop above and one stop below each lever, the stops to the five levers, respectively, being numbered in the drawings 55 and 56, 57 and 58, 59 and 60, 61 and 62, and 63 and 64. The stops are so placed and the lines so fastened to the levers that the separate movement of either of the levers 29, 33, 37, or 41 draws up the corresponding line (28, 32, 36, or 40, as the case may be) to the same extent, while the movement of the lever 43 draws up the line 40 to half the extent to which the movement of the lever 41 draws it up, since the line 40 connects with lever 43 only half as far from the center 44 as it is from the center 42 of lever 41. From this arrangement it will be seen that these levers when operated in regular succession draw out the line 24, and so rotate the axle 1 and the type-disk 2 in successive ratios which are in geometrical progression. The various parts are so proportioned that the movement of the lever 29 rotates the type-disk a distance of sixteen type-faces, the movement of the lever 33 rotates it the distance of eight, that of the lever 37 the distance of four, that of the lever 41 the distance of two, and that of the lever 43 the distance of one. Intermediate movements and the movements between the sixteen-distance movement and the complete circle are effected by the combined movements of various combinations of levers. Thus, for instance, the combined movements of the levers 43 and 41 rotate the type-disk by the distance of three type-faces and the combined movements of the levers 37, 33, and 29 rotate it by the distance of twenty-eight. These various movements are effected by the closing of the various circuits either singly or in various combinations, and as soon as the circuits are opened again the levers, lines, and pulleys descend again to the normal, the line 24 is relaxed, and the spring 25 causes the axle and type-disk to revert to the normal position, the tension of the inextensible lines preventing them from coming too far back. The arrangement is such that when they are in the normal position the impact projection 8 has opposite it the type-face which corresponds to spacing. That type-face may be so fashioned as to make a very insignificant mark when printed from, and the other type-faces have on them various characters which are all located in some convenient order to the various single and combined movements. These movements are operated by the opening and closing, singly and in various combinations, of the circuits which control the movements of the levers, lines, and pulleys, and thus it will be seen that the required letter is brought into printing position by the closing of the corresponding circuit or combination of circuits, while the printing is effected by the closing of the printing-circuit 13, and that when the circuits are opened again the various parts revert to the normal position.

The parts described thus far resemble those described in my patent specification of the United States already mentioned.

I shall now describe the electromechanical apparatus (which I have called a "compound selective relay") by which the circuits 54, 52, 50, 48, and 46 and the printing-circuit 13 are controlled by means of impulses sent along the main circuit 65. That main circuit is differentiated into five branches which respectively control the five local circuits which operate the type-wheel, the arrangement being such that owing to "resistances" and "cut-outs" successive impulses sent along the main circuit operate these local circuits successively, the intermission from impulses after each series of impulses (which may vary from one to five) closes the circuit 13 and operates printing, and the completion of the printing movements causes a momentary closing of another circuit which restores all the branches and local circuits to their normal condition ready for the next series of impulses. I shall now describe the arrangement showing how the main circuit operates the local circuits, assuming that at the outset these are in the normal condition.

The main circuit 65 has five alternative branches 66, 67, 68, 69, and 70, (shown by heavy lines and which respectively control the local circuits 54, 52, 50, 48, and 46 by means of the electromechanism now to be described.) In each case this is of the same general character except that in the last of the series it may be simplified, as described, and the description of the first applies generally to the others also. I shall now describe that arrangement with reference in the first instance to the first branch circuit 66, which controls the local circuit 54.

In the branch circuit 66 and pivoted at 71 is the soft-iron strip 72, forming an armature-switch which normally presses against the terminal 73, from which the branch circuit 66 is continued around the electromagnet 74, which is of such a character as to attract the strip whichever way the current is flowing, and thence around the electromagnets 75 and 76, between which is the upper arm of the magnetized-steel armature 77, which is pivoted at 78, the armature 77 being so magnetized and the electromagnets 75 and 76 being

so arranged and wound as to form a polarized relay. Normally the upper end of the armature 77 is between these electromagnets, while the lower end is between the electromagnets 79 and 80 and just clear of the terminals 81 and 82. The arrangement is such that a flow of current through the branch circuit 66 in one direction (which I shall call a "positive" impulse) deflects the armature 77 so as to bring its lower end into contact with the terminal 82, and a flow of current through the branch circuit 66 in the opposite direction (which I shall call a "negative" impulse) deflects the armature 77 so that its lower end is brought into contact with the terminal 81.

In the local circuit 54 is the terminal 83, against which normally rests the soft-iron strip 84, pivoted at 85; also the battery 86, the electromagnet 87, and the armature 77. From there that local circuit has two alternative courses. The longer course is through the terminal 82 and includes the electromagnet 80 and the electromagnet 53. The shorter course, which is marked 88, includes the contact 81 and the electromagnet 79, but not the electromagnet 53. Both courses unite again at the terminal 83, and the parts from that terminal to the armature 77 (both inclusive) are common to both courses. This general arrangement is such that if a positive impulse sent along the main circuit 65 passes along the branch 66 the armature 77 is deflected so that its lower end comes into contact with the terminal 82, and the local circuit 54 is closed through its longer course, so that the electromagnet 53 is energized and the type-wheel is rotated proportionally, and if a negative impulse sent along the main circuit 65 passes along the branch 66 the armature 77 is deflected so that its lower end comes against the terminal 81, and the local circuit is closed through its shorter course 88, and neither the electromagnet 53 nor the type-wheel is affected. The electromagnets 79 and 80 are so arranged that when an impulse through the branch 66 deflects the armature 77 against either terminal the consequent closing of the local circuit and energizing of the corresponding electromagnet (79 or 80) keeps the local circuit closed by keeping the armature against the terminal even after the branch circuit 66 has been opened. The arrangement is such that even a momentary impulse through the branch 66 effects these movements. The branch 66, as soon as the impulse ceases, is opened in the following way: Normally, the weight of the strip 72 keeps that strip resting against the terminal 73, and that effect is increased when, owing to the current flowing through the branch 66, the electromagnet 74 attracts the strip. This double influence is sufficient to neutralize the influence of the electromagnet 87 in the local circuit, which when the local circuit is closed tends to attract the strip 72 in the opposite direction; but when the current ceases to flow through the branch 66 and the local circuit is closed the electromagnet 74 ceases to operate, and the electromagnet 87 draws the strip 72 from the terminal 73, thus opening the branch circuit at that point and keeping it open there as long as the local circuit remains closed and forms a shunt of the main line past the first branch circuit to the second branch circuit, as hereinafter described.

The above description is typical of the way in which the other branch circuits operate the corresponding circuits, and the general result of the system may now be described.

If when all parts are in the normal condition a positive impulse is sent along the main circuit 65, it passes along the branch 66, closing the local circuit 54 through its longer course, and so rotating the type-wheel proportionally. If a negative impulse is sent along the main circuit, it passes through the branch 66, closing the local circuit 54 through its shorter course 88 and not rotating the type-wheel, and on the cessation of the impulse (whether positive or negative) the first branch circuit 66 is opened at 73 and is kept open there as long as the local circuit 54 remains closed. If with the branch circuit 66 thus open another impulse is sent along the main circuit 65, it will pass through the branch 67 with corresponding effect. If positive, it will close the local circuit 52 through the longer course and rotate the type-wheel proportionally. If negative, it will close that local circuit through its shorter course 89 and will not operate the type-wheel, and on the cessation of the impulse (whether positive or negative) the second branch 67 will be opened at 90 and will be kept open there as long as the local circuit 52 remains closed. If with the branches 66 and 67 thus open another impulse is sent along the main circuit 65, it will pass through the branch 68 with corresponding effect. If positive, it will close the local circuit 50 through its longer course and rotate the type-wheel proportionally. If negative, it will close that local circuit through its shorter course 91 and will not operate the type-wheel, and on the cessation of the impulse (whether positive or negative) the third branch 68 will be opened at 92 and will be kept open there as long as the local circuit 50 remains closed. If with the branches 66, 67, and 68 thus open another impulse is sent along the main circuit 65, it will pass through the fourth branch 69 with corresponding effect. If positive, it will close the local circuit 48 through its longer course and rotate the type-wheel proportionally. If negative, it will close that local circuit through its shorter course 93 and will not operate the type-wheel, and on the cessation of the impulse (whether positive or negative) the fourth branch 69 will be opened at 94 and will be

kept open there as long as the local circuit 48 remains closed. If with the branches 66, 67, 68, and 69 thus open another impulse is sent along the main circuit 65, it will pass through the fifth branch 70 with corresponding effect. If positive, it will close the local circuit 46 through its longer course and rotate the type-wheel proportionally. If negative, it will close that local circuit through its shorter part 95 and will not operate the type-wheel. This being the last of the series, there is no need for the parts designed to open the branch of the main circuit. The shorter course 95 (with the electromagnet and terminal in it) is superfluous in this last-mentioned case, though it may be used in a variation presently to be described.

To secure the result that the successive impulses of a series shall pass through the branch circuits in regular succession, as described, it is necessary to prevent an impulse along the main circuit 65 from passing along any of the branches 67, 68, 69, or 70 so long as any higher branch is closed, and for this purpose the resistances 96, 97, 98, and 99 are inserted, as shown. In order to lessen the obstruction which these resistances would offer after the branches opposite them are open, the circuit has below each resistance the terminals 100, 101, 102, and 103, respectively, which operate as contact-stops to the strips 72, 104, 105, and 106, respectively, so that in each case when the branch is open the next flow of current instead of passing through the resistance may pass through the strip and the terminal, which forms a shunt of the main line past the first branch circuit to the second and from the second to the third, according to the position of the armature-switches.

As already stated, in each series of impulses the rotary effects on the type-wheel are cumulative, and the printing movement is effected by the longer intermission of impulses after each series of impulses, (which may vary from one to five,) the intermission between the successive movements (if more than one) in each series being so short that the printing electromechanism has not time to operate till the longer intermission takes place at the end of the series.

The way in which the rotation of the type-wheel is followed by the printing movement may now be described. In the main circuit 65 above where it branches is inserted the electromagnet 107, opposite which and working as an armature attracted by that magnet, whether energized by positive or by negative impulses, is the soft-iron strip 108, pivoted at 109 and opposite which is another soft-iron strip 110, pivoted at 111. These strips operate as terminals for the printing-circuit 13, in which is the battery 112. Normally these strips hang just clear of one another; but when the strip 108 after being attracted to the electromagnet 107 has time to swing back far enough it comes temporarily into contact with the strip 110. Every impulse, whether positive or negative, sent along the main circuit 65 causes the electromagnet 107 to attract the strip 108, and in each series the impulses follow one another so rapidly that the strip 108 has not time to swing back as far as the strip 110; but at the close of each series (which, as described, may vary from one to five impulses) the longer intermission gives time for the strip 108 to swing back as far as the strip 110, and the coming into contact of these strips closes the printing-circuit 13, energizes the electromagnet 12, and thus effects printing, the parts which effect the printing and the spacing returning to the normal position when the strips revert to the normal.

After each printing stroke the closing of the branches 66, 67, 68, 69, and 70 and the opening of the local circuits 54, 52, 50, 48, and 46 (so as to restore all parts to the normal ready for the next series of impulses) are effected thus: Opposite the pivoted strips 84, 113, 114, 115, and 116 (which are parts of the five local circuits, respectively, and which normally complete these circuits by being in contact with the terminals 83, 117, 118, 119, and 120, respectively) are the electromagnets 121, 122, 123, 124, and 125, all in the circuit 126. As often as this circuit is closed these electromagnets draw the strips away from the terminals, thus opening all the local circuits at these points and letting the parts both of the local circuits and the branches return to the normal, and on the opening of the circuit 126 these strips also revert to their terminals, so that the whole system is ready for the next series of impulses. The operations just described are of course superfluous in the case of any branch and local circuit not affected by the preceding series of impulses.

The circuit 126 is completed through the battery 112, (which operates it, as well as the circuit 13, the parts from 127 to 128 being common to both circuits,) the terminal 129, the strip 130, pivoted at 131, and the resistance 132. The end of the strip 130 rests on the end of the lever 9, so that normally it is just clear of the terminal 129, but that when that end of the lever descends with the printing stroke the strip 130 comes into contact with the terminal 129 and so closes the circuit 126 until the last part of the return movement of the lever 9 lifts it clear of the terminal again. The resistance 132 in the circuit 126 causes the current from the battery 112 to pass along the circuit 13 in preference to the circuit 126 when both these circuits are closed; but as soon as the circuit 13 is opened the current flows through the circuit 126 till that circuit is also opened, which takes place at the last part of the return

movement of the lever 9 after the printing stroke. Thus after each printing movement the circuit 126 is closed and opened again, thus causing the various parts of the branches and the local circuits to revert to the normal ready for the next series of impulses. It will thus be seen that the series of impulses (varying from one to five and of variable polarity) are used to regulate the rotation of the type-wheel, that the intermissions at the end of each series effect printing, and that the return movement after that causes the various parts to revert to the normal ready for the next impulse.

The characters may be allotted to the various series of impulses in any convenient way. As a negative impulse does not rotate the type-wheel, I prefer to allot the single negative impulse to spacing, and as "e" is the most commonly-used letter in the alphabet I prefer to allot the single positive impulse to it. For the other characters I prefer to approximate the combinations to the combinations of the Morse code, making positive and negative impulses correspond to dots and dashes. It will be observed that the negative impulses (except the first, which when used alone operates spacing) are ineffective except to close the corresponding local circuit and to open the corresponding branch, so as to cause the next impulse to go through the next branch and to operate the next local circuit. Consequently a negative impulse at the close of a series is superfluous, and each series should end with a positive impulse. To this extent it is necessary to modify the Morse or other selected code.

I have described the type-wheel as having thirty-two sides, and as being operated by a fivefold series of magnets, levers, circuits, and other fittings; but I do not limit my invention to these particular numbers, and they may be varied. It may be observed that a type-wheel having sixty-four sides may be operated by the insertion in the system described of a further pulley, line, lever, and electromagnet, thus making a sixfold in place of a fivefold series. Such a series may be operated without increasing the number of branches and local circuits by utilizing the shorter course 95 of the local circuit 46 to operate its magnet. In that case the negative impulse will be effective to rotate the type-wheel if it comes fifth in a series of five. In this variation the six local circuits which control the six levers which govern the rotation of the type-wheel rotate that type-wheel in the ratios of one, two, four, eight, sixteen, and thirty-two, respectively.

I shall now describe several variations in the mode by which the branch circuits may control the local circuits, taking in each case the first branch and the first local circuit as typical of the others also.

Fig. 2 shows a variation in which the electromagnets 75 and 76 in Fig. 1 are eliminated, and the branch 66 operates the armature 77 by being suitably wound around the electromagnets 79 and 80, which electromagnets are then both in the circuit 54 and in the circuit 66, these two circuits, however, being quite separate from one another.

Fig. 3 shows a variation in which the electromagnets 75 and 76 in Fig. 1 are eliminated, and the branch 66 operates the armature 77 by passing through a coil of wire 133, as in a galvanometer.

Fig. 4 shows a variation suitable for wireless telegraphy, in which the variations of impulse differ, not in direction, but in length, long and short taking the place of positive and negative. To meet this case, there are inserted in the branch 66 two electromagnets 134 and 135. The electromagnet 134 has opposite it the upper end of the soft-iron armature 77, pivoted at 78, so that when the electromagnet 134 attracts it the lower end is brought into contact with the terminal 81 in the shorter course 88 of the circuit 54, which includes the electromagnet 79. The electromagnet 135 has opposite it the soft-iron armature 136, pivoted at 137, the end of which normally rests on the stop 138, and the movements of which are retarded by its being connected by the line 139 to the loosely-fitted piston 140, working in the liquid dash-pot 141, the resulting retardation being such that the relatively short impulses are not sufficiently long to bring the armature 136 into contact with the terminal 142, while the relatively long impulses do so. Thus if the impulse through the branch is short it closes the circuit 54 through its shorter course 88 and does not effect printing, and if the impulse is long that movement is followed by the closing of the circuit 54 at 142, and when this happens the current flows through the longer course 54 (actuating the type-wheel) in preference to the shorter course 88, owing to the resistance 143, inserted in the latter to secure this result, when both courses are closed. By this arrangement the long and short impulses of wireless telegraphy may be made to operate the system in the same way as the positive and negative impulses of ordinary telegraphy.

For convenience of description I have described the invention as applied to a simple form of telegraph-receiver, having an axle bearing a single type-wheel and printing the characters along a fillet of paper; but I do not limit my invention to this particular application, and it may be applied equally whether the axle carries one type-wheel or two type-wheels or a type-cylinder.

I claim—

1. A printing-telegraph, comprising rotary adjustable printing-type, a series of electromechanical devices each giving a different throw to said printing-type, a main-line cir-

cuit, a series of selective branch circuits all connected to the main line and each connected to and operating its own electromechanical type-moving mechanism, each of said selective branch circuits comprising a local-battery circuit with two paths, one of which paths passes through the electromechanical type-moving device, and an electrically-differentiating device in each branch circuit acted upon by differentiated impulses of the main line, and adapted to throw each local branch circuit through either of its two paths to operate or not operate the electromechanical type-moving mechanism.

2. A printing-telegraph, comprising rotary adjustable printing-type, a series of electromechanical devices each giving a different throw to said printing-type, a main-line circuit, a series of selective branch circuits all connected to the main line and each connected to and operating its own electromechanical type-moving mechanism, each of said selective branch circuits comprising a local-battery circuit with two paths, one of which paths passes through the electromechanical type-moving device, an electrically-differentiating device in each branch circuit acted upon by differentiated impulses of the main line, and adapted to throw each local branch circuit through either of its two paths to operate or not operate the electromechanical type-moving mechanism, a resistance between the main-line branches, an electromagnet located in the local circuit of each branch, and a shunting-armature switch operated by said last-named electromagnet to cut out the differentiating device of one branch and shunt the line to the next branch.

3. A printing-telegraph, comprising rotary adjustable printing-type, a series of electromechanical devices, each giving a different throw to said printing-type, a main-line circuit, a series of selective branch circuits, all connected to the main line and each connected to and operating its own electromechanical type-moving mechanism, each of said selective branch circuits comprising a local-battery circuit with two paths, one of which paths passes through the electromechanical type-moving device, an electrically-differentiating device in each branch circuit acted upon by differentiated impulses of the main line and adapted to throw each local branch circuit through either of its two paths to operate or not operate the electromechanical type-moving device, a type-hammer with electromagnet and circuit operating the same, a circuit-closing device for the hammer-circuit and an electromagnetic device arranged in the main line and adapted to operate upon and close the hammer-circuit at the end of a differentiating movement.

4. A printing-telegraph, comprising rotary adjustable printing-type, a series of electromechanical devices each giving a different throw to said printing-type, a main-line circuit, a series of selective branch circuits all connected to the main line and each connected to and operating its own electromechanical type-moving mechanism, each of said selective branch circuits comprising a local-battery circuit with two paths, one of which paths passes through the electromechanical type-moving device, an electrically-differentiating device in each branch circuit acted upon by the differentiated impulses of the main line and adapted to throw each local branch circuit through either of its two paths to operate or not operate the electromechanical type-moving device, a type-hammer with electromagnet and circuit operating the same, a circuit-closing device for the hammer-circuit, an electromagnetic device arranged in the main line and adapted to operate upon and close the hammer-circuit at the end of a differentiating movement, an armature-switch holding each local branch circuit closed, and an electromagnet for each switch for opening each local branch circuit, said electromagnet being arranged in a circuit opened by the printing mechanism.

5. A printing-telegraph, comprising rotary adjustable printing-type, a series of electromechanical devices each giving a different throw to said printing-type, a main-line circuit, a series of selective branch circuits all connected to the main line and each connected to and operating its own electromechanical type-moving mechanism, each of said selective branch circuits comprising a local-battery circuit with two paths, one of which paths passes through the electromechanical type-moving device, an electrically-differentiating device in each branch circuit acted upon by the differentiated impulses of the main line and adapted to throw each local branch circuit through either of its two paths to operate or not operate the electromechanical type-moving device a type-hammer with electromagnet and circuit operating the same, a circuit-closing device for the hammer-circuit, an electromagnetic device arranged in the main line and adapted to operate upon and close the hammer-circuit at the end of a differentiating movement, an armature-switch holding each local branch circuit closed, and an electromagnet for each switch for opening each local branch circuit, said electromagnet being arranged in a circuit opened by the printing mechanism, a single battery operating both the circuit of the printing-hammer and the circuit of the opening-magnets of the branch circuits, and a resistance placed in the latter circuit.

6. The compound selective relay for working a printing-telegraph as described, consisting of main-line branches, local circuits and electromagnets arranged in groups corresponding to the main-line branches, whereby the successive impulses of a series of im-

pulses sent along the main circuit serve to operate the local circuits in succession, printing mechanism arranged to operate in the intermission at the close of such impulses, and circuit-opening devices for the groups operated by the return from the printing stroke, whereby all the parts are returned to their normal positions, ready for the next series of impulses.

7. The combination with a series of electromagnets each arranged to perform a separate work, of a corresponding series of selective branch circuits and a main-line circuit extending through all of them, each of said selective branch circuits having also a local-battery circuit with two paths, one of which passes through the said electromagnet, an electrically-differentiating device in each branch circuit acted upon by differentiated impulses of the main line and electromechanical shunting devices for sending the differentiated impulses of each series of impulses transmitted along the main-line circuit consecutively through the several branch circuits in regular succession.

JAMES DUNDAS WHITE.

Witnesses:
C. LEDGER,
ELIZABETH A. KILBY.