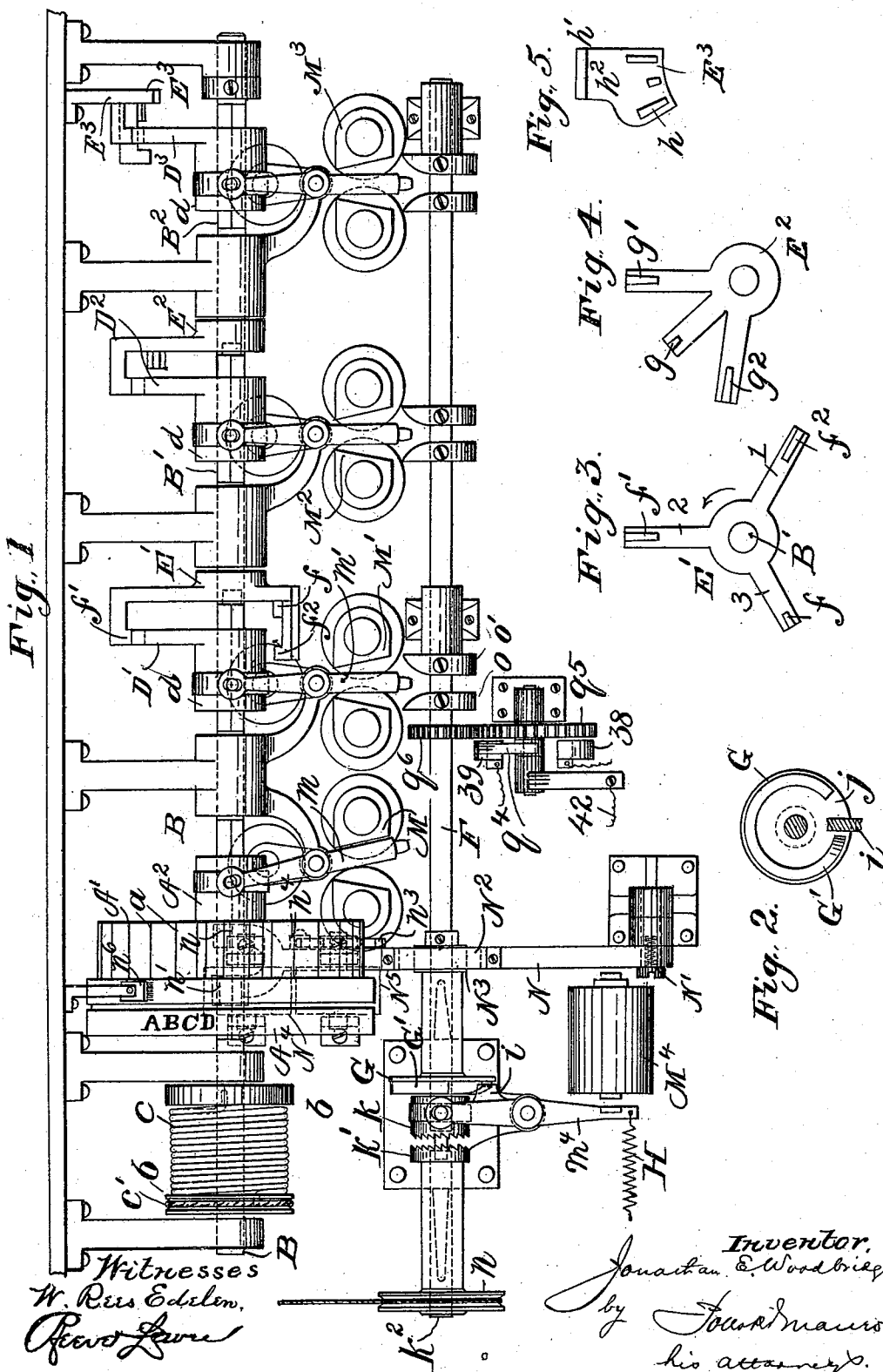


J. E. WOODBRIDGE.  
PRINTING TELEGRAPH SYSTEM.

No. 549,179.

Patented Nov. 5, 1895.



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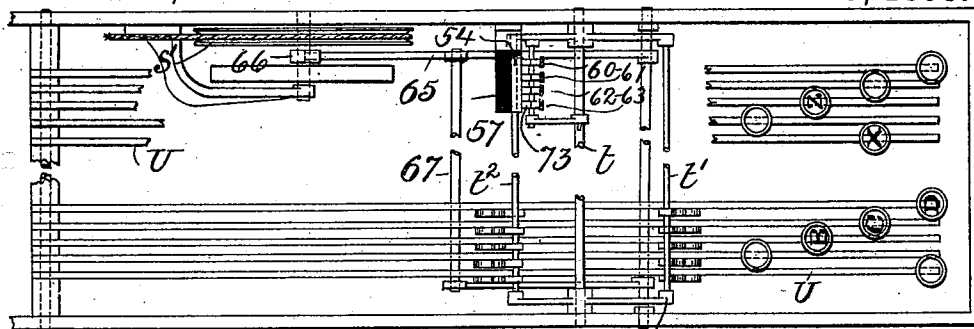


Fig. 7.

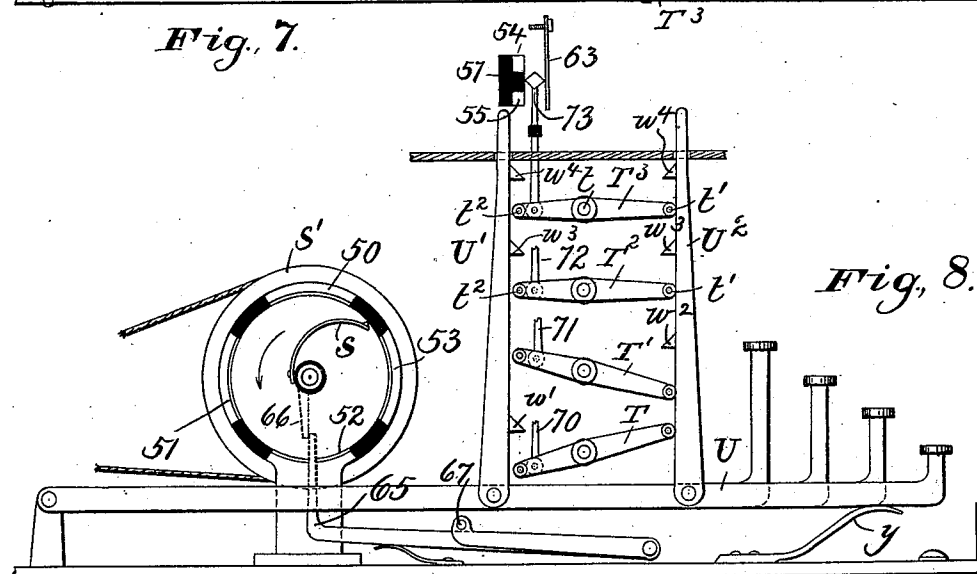


Fig. 8.

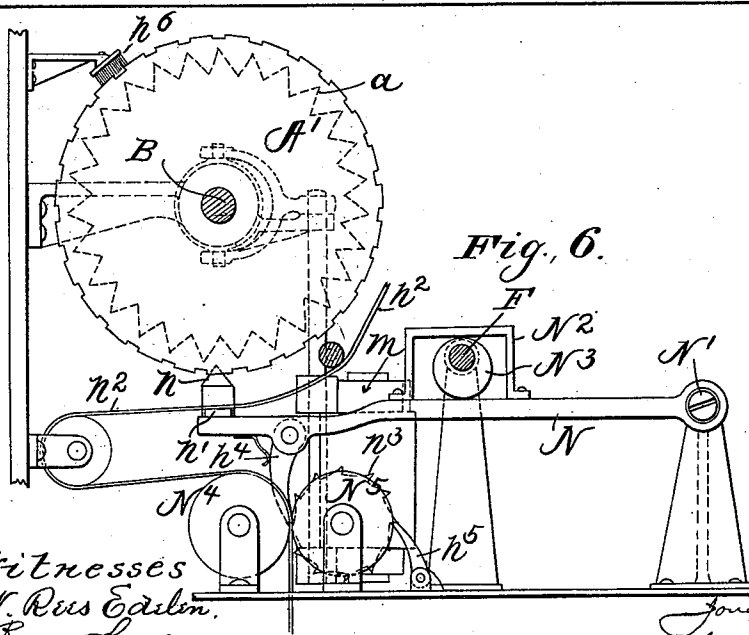


Fig. 6.

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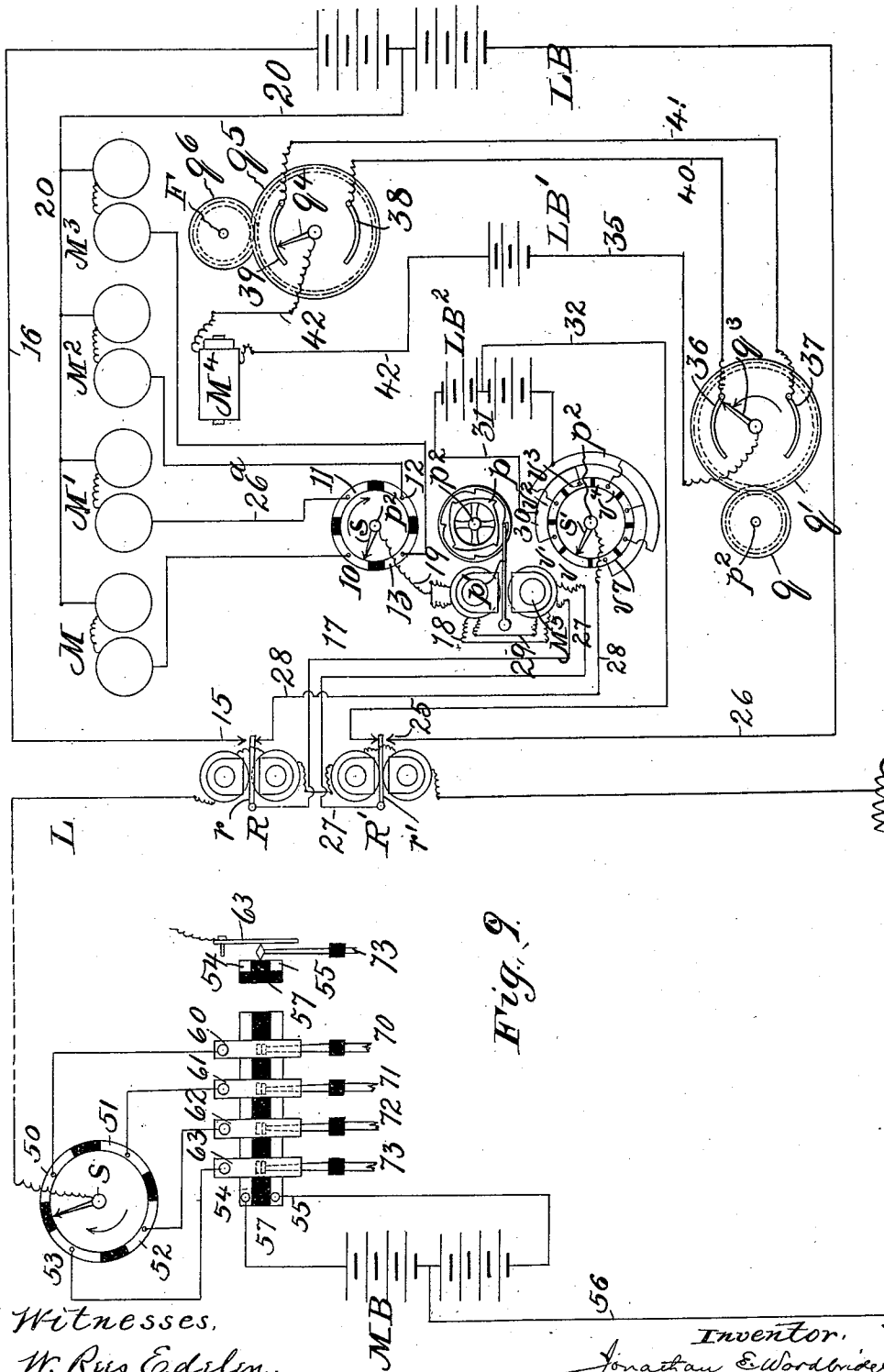
(No Model.)

3 Sheets—Sheet 3.

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# UNITED STATES PATENT OFFICE.

JONATHAN E. WOODBRIDGE, OF DULUTH, MINNESOTA.

## PRINTING-TELEGRAPH SYSTEM.

SPECIFICATION forming part of Letters Patent No. 549,179, dated November 5, 1895.

Application filed January 29, 1895. Serial No. 536,581. (No model.)

*To all whom it may concern:*

Be it known that I, JONATHAN E. WOODBRIDGE, of Duluth, Minnesota, have invented a new and useful Improvement in Printing-Telegraph Systems, which improvement is fully set forth in the following specification.

This invention relates to printing-telegraphs, and more particularly to systems employing a type-wheel having characters arranged on its periphery and adapted to be turned to bring any desired character to the printing position.

The general objects of my invention are, first, to increase the rapidity of transmission by diminishing the movements necessary and the time required to bring the type-wheel to the printing position, and, second, to simplify greatly the printing mechanism and other parts of the system.

More specifically, the objects sought and results attained (among others) by my invention are the following:

First, to operate over one wire with currents of uniform duration and uniform strength, avoiding the uncertainties and complications attending the use of extra strength and variable-length currents.

Second, to avoid the use of synchronism, unison devices, and specially-constructed relays.

Third, to give a wide range of characters with a small number of line-impulses, the system herein described being capable of printing fifty-four characters with a maximum of four line-impulses per character.

Fourth, to reduce to a minimum the number and functions of magnets. By this system the total number of magnets has been reduced to six (exclusive of relay-magnets.)

Fifth, to furnish a simple and reliable transmitting apparatus.

Sixth, to furnish a system in which the battery-circuits are all normally open (*i. e.*, when the system is in a state of rest) and one which is capable of being organized and used for differential duplexing.

I will describe herein a system designed to accomplish the foregoing objects and attended with other advantages, as will be hereinafter pointed out.

It has been heretofore proposed, instead of advancing the type-wheel step by step, to

give it a continuous movement and provide it with a series of stops and with mechanism for selecting any of the desired stops and for throwing it into position to arrest the type-wheel. Such systems are for the most part very elaborate and complicated and involve the use of a large number of circuits and magnets. It has also been proposed to employ a series of independent impelling devices, operated, respectively, by separate magnets in various possible combinations, for positively rotating or pushing the type-wheel to any one of its printing positions, according to the impelling device, or combination of impelling devices, which is thrown into operation. Such system is much simpler than the ordinary step by step or the synchronous mechanism; but its use puts considerable work upon the magnets, and it is necessary after printing each character to restore all parts to their initial positions before operating a combination for the next character. Other difficulties distinguishing my system from the foregoing will be hereinafter pointed out. It has also been proposed heretofore to impel the type-wheel by a motor thrown into connection with the type-wheel by means of a magnet operated by a line-impulse, and to determine the extent of movement of the type-wheel by a series of interacting stops, each controlled by a magnet adapted to be operated by a line-impulse. In the system here referred to the type-wheel, after each printing stroke, with all the displaced parts of the arresting mechanism, had to be restored to zero by a reverse movement of the wheel-shaft. Three main circuits were required to work the various releasing, arresting, and restoring mechanisms, and extra-strength currents were also utilized in the operation of the system.

The present invention embraces a printing-wheel whose point of arrest after release is determined by a combination of stops, preferably three in number, each controlled by an impulse from the transmitting-station, and mechanism for operating the stops singly and in combination, so that the type-wheel can be arrested at any one of its printing positions. The operating-magnets therefore have only to fix the position of a stop which finally arrests the type-wheel, instead of im-

5 pelling the shaft of the type-wheel. The latter can be connected by a frictional or slip connection with any constantly-running motor, so that it is very sensitive and prompt in action. Another gain in time is effected by reason of the fact that as soon as one printing stroke is made, or indeed while it is being made, the combination of stops for the next character can be set up. The wheel thus rotates constantly in one direction, and not only is the time saved which is usually consumed in restoring it to the starting-point, but all unison or retracting mechanism is dispensed with. This non-restoring type-wheel is one of the important and distinguishing features of my invention.

10 The capacities or ranges of action of the shiftable stops are represented by the powers of three, instead of by the terms of the series of two, as heretofore. In other words, each stop may be regarded as having three possible positions—one a normal or resting position, one a positive-current position, the third a negative-current position. Thus with one such movable stop a wheel can be arrested (after being started) at any one of three positions; with two such stops, at any one of nine positions, and with three, at any one of twenty-seven positions. A fourth stop and operating mechanism therefor would provide for eighty-one positions; but it is preferred to use only three stops and to arrange the type in two lines of twenty-seven each. Thus, with suitable shifting mechanism, the system provides for fifty-four characters and requires only a maximum of four impulses for each character, one of which impulses operates the shifting-magnet and the other three operate the stop-magnets. The use of combinations made up of three elements and of shiftable stops each having three functional positions instead of two, as heretofore employed, is an important feature of the invention.

45 The invention embraces mechanism of a very simple character for producing the printing stroke, and also improved transmitting mechanism, though, obviously, any transmitter capable of sending the positive and negative impulses to line in the desired combination could be employed.

50 The invention further embraces certain other improvements in details and arrangements of devices and circuits, as will be hereinafter explained, and specifically pointed out in the claims at the end of this specification.

55 In the accompanying drawings, Figure 1 is a plan view of the receiving mechanism. Fig. 2 is a detail view of part of the operating mechanism for the printing-shaft. Figs. 3, 4, and 5 are elevations, respectively, of the three stops. Fig. 6 is an end view of the receiving mechanism. Figs. 7 and 8 are respectively a plan and elevation of the transmitting mechanism. Fig. 9 is a diagrammatic view of the circuit arrangements and the different elements of the mechanism.

A represents a printing-wheel of ordinary

construction, having type arranged in two rows. Attached to the printing-wheel is a locking-wheel A', having a series of notches  $\alpha$ , for purposes hereinafter explained, and a collar A<sup>2</sup>. These parts are all one piece and are feathered on the shaft B, so as to turn therewith, and also to be capable of movement lengthwise thereof to bring either of the rows of type into the printing position. As shown, the right-hand row is in the printing position, and in the drawings all the parts are shown in their usual or normal position.

On shaft B is a pulley *b*, loose thereon, but connected with a disk *b'*, fast thereon, through a helical spring *c*. Pulley *b* is driven by a cord *c'*, adapted to slip thereon when the spring acquires a certain tension. Any other suitable driving mechanism may be used, but that illustrated causes the type-wheel to start promptly when released and to turn quickly until arrested. The shift of the type-wheel is effected by a shift-magnet M, whose armature-lever *m* is forked at the end and carries pins engaging in a groove in collar A<sup>2</sup>, the construction being common and well known for the purpose here in view.

M<sup>1</sup> M<sup>2</sup> M<sup>3</sup> represent the three stop-magnets, which are shown as electromagnetically-polarized magnets. The armature-lever *m'* of the first stop-magnet is connected (in the same manner as described above for armature-lever *m*) with a sliding hub or collar *d*, also feathered on shaft B.

Collar *d* carries the first of the stop-arms D', and shaft B ends just beyond this arm, from which point an independent shaft B' extends in the same line. On this shaft B' is fixed the movable stop E', having three arms 1 2 3, (see Fig. 3,) each with an angular finger *f f' f''* on its extremity. It will be observed that these fingers are in different vertical planes. Arm D', as shown, is resting against and is arrested by finger *f'*, the armature-lever *m'* being in its intermediate position. If the armature be attracted to the right, arm D' will move to the left, out of the path of finger *f'*, and rotate until it encounters finger *f''*. A corresponding movement in the opposite direction will bring the stop-arm D' into the path of finger *f*. These three fingers or stops are arranged one hundred and twenty degrees apart, and by means of this first of the series of stop mechanisms it is plain that by a positive impulse, a negative impulse, or no impulse at all, the type-wheel may be made to assume one of three definite positions.

The other two of the series of stop-mechanisms are similar in construction and operation to the first, differing only in the location of the stop-fingers. Magnet M<sup>2</sup> controls a stop-arm D<sup>2</sup>, identical with arm D' and capable of assuming any one of three positions. Fingers *g g' g''* (see Fig. 4) of stop E<sup>2</sup> are in different vertical planes, and their angular positions with reference to the shaft are such that they divide the arc between any two

fingers  $f f' f^2$ —i. e., an arc of one hundred and twenty degrees—into three equal parts. Stop  $E^2$  is also fixed on a shaft  $B'$ , which begins where shaft  $B$  ends.

5 The third stop mechanism has the three fingers  $h h' h^2$  of stop  $E^3$  a distance of one twenty-seventh of a circumference apart. Stop  $E^3$ , which is the last or final stop and fixes the ultimate point of arrest of the type-  
10 wheel, is not carried by a movable shaft, like stops  $E^1 E^2$ , but is fixed to a stationary support.

The action of the stop mechanism as a whole will now be readily understood. For  
15 the purpose of explanation we will assume that positive impulses throw the armatures to the right and negative impulses to the left. The first impulse of any combination operates the shift-magnet  $M$ . If this be a plus impulse there would be no shift in the position  
20 shown in Fig. 1, since the armature is already attracted to the right-hand pole of the magnet; but this first impulse (whether positive or negative) starts the commutator, which  
25 successively brings the stop-magnets into circuit with a generator, as will presently be explained. Consequently at the second impulse the circuit of magnet  $M'$  is closed. If  
30 this impulse be positive, arm  $D'$  shifts to the left, escapes from finger  $f'$ , and shaft  $B$  rotates two-thirds of a revolution. If the desired character happens to be just eighteen divisions from the starting-point there will  
35 be no further impulses in the particular combination transmitted, and consequently the second and third stop mechanisms will not be operated. In like manner a minus impulse  
40 through magnet  $M'$  will permit the type-wheel to rotate one-third of a revolution and arrest it at the end of nine divisions.

If the desired character be not at one of the three positions controlled by the first stop mechanism, one or both of the other mechanisms must be called into operation. Thus,  
45 if the next impulse be plus, (the circuit of magnet  $M^2$  being then closed,) arm  $D^2$  will shift to the left, shaft  $B'$  will be free to turn, the shaft  $B$  will turn as far as permitted by the first stop mechanism and two-ninths of a  
50 revolution farther. If the third impulse be negative, the additional movement of the shaft  $B$  and type-wheel will be one-ninth of a revolution. In like manner the third stop mechanism may allow a further revolution  
55 of one twenty-seventh or two twenty-sevenths of a revolution, and by a single or combined action of the several mechanisms the wheel can be turned to any desired one of twenty-seven angular positions, the magnets  
60 having no work to do except to shift the stops. Conversely stated, for the shortest movements (one step or two) stop-magnet  $M^3$  alone is actuated, there being no impulses at the times when magnets  $M^2 M'$  are in circuit.  
65 For movements of greater range (four to nine) magnet  $M^2$  alone or  $M^2$  and  $M^3$  are actuated. For movements of the greatest range magnet

$M'$  alone, or in combination with one or both the other magnets, is actuated.

The mechanism for giving the printing  
70 stroke is also of very simple construction. The printing-magnet  $M^4$  is brought into circuit, as will be presently explained, just after the four impulses comprising a signal have  
75 passed over the line. Armature  $M^4$  of this magnet throws the movable member  $k$  of an ordinary clutch into engagement with the relatively stationary member  $k'$ , the latter  
80 being carried by a shaft  $k^2$ , which also carries a constantly-rotating pulley  $n$ , driven from any suitable motor. Member  $k$  of the  
clutch is feathered on the printing-shaft  $F$ , which therefore immediately begins to rotate. On the shaft is a disk  $G$ , having an annular  
85 cam  $G'$ , (see Fig. 2,) cut away or grooved at  $j$ . In this groove a projection  $i$  on the armature-lever  $m^4$  rests when the parts are in their  
normal positions; but as soon as shaft  $F$  begins to revolve, cam  $G'$  engages this projec-  
90 tion, keeping the two parts of the clutch together, so that, although the circuit of magnet  $M^4$  is immediately opened, the printing-shaft  
makes one complete revolution, being arrested when groove  $j$  once more comes opposite pro-  
95 jection  $i$  and the armature-lever can be retracted by its spring  $H$ .

$N$  represents the printing-lever, pivoted at  
100  $N'$  and carrying the strap  $N^2$ , (see Figs. 1 and 6,) which surrounds eccentric  $N^3$  on shaft  $F$ , so that at one revolution of shaft  $F$  the printing-lever is vibrated positively in both direc-  
105 tions. Lever  $N$  carries a wedge-shaped point or tooth  $n$ , which at its upward movement enters one of the twenty-seven notches in locking-wheel  $A'$ , heretofore referred to, both  
momentarily arresting the type-wheel and also bringing it accurately to the printing position. Lever  $N$  also carries a printing-pad  $n'$ ,  
110 over which passes a strip of paper  $n^2$ , which passes between feed-rolls  $N^4 N^5$ . The latter has a ratchet-wheel  $n^3$ , worked by a pawl  $n^4$  on the printing-lever  $N$ , and a detent  $n^5$  is provided to engage said ratchet-wheel. The  
type-wheels may be inked by a brush  $n^6$ .

Obviously the printing and paper-feed  
115 mechanism can be of any suitable description.

Shaft  $F$  is also utilized to bring the arma-  
120 tures of the stop-magnets to their normal or intermediate position, ready to be properly operated by the next impulse which passes through the magnets. To this end the extremity of each armature-lever  $m' m^2 m^3$  lies  
125 between the faces of two cams  $O O'$  on shaft  $F$ . Normally, as shown in the drawings, the end of each lever is between the curved faces of the cams where the groove or space  
between them is widest, and hence is free to move in either direction. When an arma-  
130 ture has been shifted, the curved face of one of the cams restores it gradually to its normal position, as the cam is rotated with shaft  $F$ .

It will be observed that as soon as tooth  $n$

releases the type-wheel (which it detains only for a small fraction of a second) the latter is free to continue its march to the next resting-point, and that in the meantime the stops may be set or be in process of being set for the next character, there being no need of restoring the type-wheel to its initial position between successive printing operations, as in most systems. After a message has been printed, the type-wheel will simply continue to rotate until it reaches its initial point, since all the stops will in that case return to their normal positions. (Shown in Fig. 1.)

To fully understand the operation of the receiving mechanism it is necessary to refer to Fig. 9, in which the circuit arrangements and the different elements of the mechanism are illustrated diagrammatically.

The circuits of the shift-magnet M and stop-magnets M<sup>1</sup> M<sup>2</sup> M<sup>3</sup> are controlled by an ordinary revolving switch-arm s, which makes contact, successively, with the four contact-plates 10, 11, 12, and 13 of a commutator. These magnets are in multiple-arc branches of a local battery LB, magnet M being connected with commutator-plate 10, M<sup>1</sup> with plate 11, M<sup>2</sup> with plate 12, and M<sup>3</sup> with plate 13. The arbor p<sup>2</sup> of switch-arm s also carries an escapement-wheel p, a second switch-arm s, and a pinion q. The main line L passes through the polarized relays R R', which may be of ordinary construction, and thence to ground. M<sup>5</sup> represents the polarized escapement-magnet which operates the escapement-lever p', the latter co-operating with the double escapement-wheel p to permit its shaft to complete one revolution in eight steps. Magnet M<sup>5</sup> is a differential double-wound magnet, as indicated, the reason for which will presently appear.

It will be seen that my system requires the use of only six magnets in all (exclusive of the relay-magnets) and the work of each is comparatively slight, permitting the use of a small amount of energy and tending toward certainty and promptness of action.

Pinion q drives a gear-wheel q', having twice as many teeth as said pinion, and whose arbor carries the arm q<sup>3</sup> of a "three-point" switch. The arm q<sup>4</sup> of a similar switch is carried by the shaft of a gear q<sup>5</sup>, driven from a pinion q<sup>6</sup> (having half the number of teeth) on printing-shaft F. (See, also, Fig. 1.) Printing-magnet M<sup>4</sup> is in the circuit of these switches, which circuit has a local battery LB'.

Assuming that R is the positive relay and that the first impulse of a signal is plus, the following actions will occur: Armature of relay R touches its front contact 15 and a circuit is made from the plus pole of battery LB by wire 16, point 15, armature r, wire 17, through one winding of escapement-magnet M<sup>5</sup>, passing from one coil to the other by wire 18; thence by wire 19 to switch-arm s, commutator-plate 10, shift-magnet M, and by wire 20 to the battery LB.

The operation of the shift-magnet is understood, but the excitation of the escapement-magnet M<sup>5</sup> draws lever p' to one side, releasing the tooth of the outer rim of the escapement-wheel p, permitting the latter and shaft p<sup>2</sup> to turn one-eighth of a revolution. This leaves switch-arm s still on plate 10; but as armature r at once returns to its back contact a circuit is closed, as presently described, through the auxiliary battery LB<sup>2</sup>, carrying a current in the opposite direction through the escapement-magnet, the effect being to vibrate arm p' back to the position shown in the drawings, turning shaft p<sup>2</sup> another step and carrying arm s over to plate 11 of the first stop-magnet M'.

The circuit of the auxiliary battery above referred to is as follows: The rotation of shaft p<sup>2</sup> has carried switch-arm s' from the dead plate v of the auxiliary commutator to the first live plate v', (and it will be seen that there are eight of these plates, while the main commutator has but four.) Starting at the back stop of the positive relay, the circuit proceeds by wire 28 to switch-arm s', plate v, wires 30, 31, to the plus pole of the battery LB<sup>2</sup>, by wire 32 to the back-stop of the negative relay R', over armature-lever r', wire 27, to one winding (represented by the wire 29) of the differential escapement-magnet, back through the other winding 18 to wire 17 and armature-lever r to the point of beginning.

It may be observed that winding 18 of the magnet M<sup>5</sup> is connected with the positive relay and winding 29 with the negative relay, and that when the armatures of both relays are on the back or resting contacts the current, after passing through one of the windings, returns through the other, (the currents being in opposite directions in the reversely-wound coils, thereby reinforcing each other,) and that only when one relay-armature is on its front contact does the local battery LB come into circuit through one of the stop-magnets. The same movement of the escapement-wheel which carried arm s to plate 11 carried arm s' to the second live plate v<sup>2</sup>, which is connected to the opposite pole of the auxiliary battery LB<sup>2</sup>. If now no main-line impulse immediately follows the first, as is the case when the first stop mechanism in the combination is not to be shifted either to the right or left, the auxiliary commutator and battery are in position to work the escapement-arm, thus performing the function of a line-impulse. That case will be considered presently, and it will first be assumed that in the combination being transmitted another impulse immediately follows the first, and that its sign is minus. In such case the negative relay R' responds, attracting lever r' to front stop 25. The circuit can then be traced from point 25 by wire 26 to battery LB, thence by wire 20 through magnet M', by wire 26<sup>a</sup> to commutator-plate 11, through switch-arm s, wire 19, winding 29 of escapement-magnet M<sup>5</sup>, wire 27 and armature-le-

ver  $r'$  to the point of beginning. The current through the escapement-magnet is in this case in the opposite direction to that of the current produced by the action of relay R; but as windings 18 and 29 are reversed, as already stated, the effect is the same—namely, to draw lever  $p'$  from engagement with the outer row of teeth of wheel  $p$  into engagement with the inner row of teeth. Shaft  $p^2$  thus turns another step, bringing arm  $s'$  into engagement with plate  $v^3$ , and the auxiliary battery is brought into operation, as before, returning lever  $p'$  and moving arm  $s$  to plate 12. Thus if the combination consists of four line-impulses, of whatever sign, the escapement-arm is actuated in one direction by currents from the local battery LB and returned by currents from the auxiliary battery LB<sup>2</sup> until shaft  $p^2$  has completed a revolution. The system, however, provides that the omission of impulses shall have a significance in the code of signals. In other words, the signals are all compounded of three elements—namely: first, plus impulses; second, minus impulses; third, no impulses. When, therefore, in the transmission of a signal, the “no impulse” element is used the auxiliary commutator comes into play to perform the usual function of line-impulse and work the escapement-magnet forward. What actually happens at such time is that there is an extra-long interval between the signals, an interval equal to the usual duration of an impulse plus the usual duration of two breaks. It will be seen that after a line-impulse has worked the escapement-arm and the auxiliary commutator has returned it, the switch-arm  $s'$  will be in contact with one of the plates  $v^2$   $v^4$   $v^6$ , which are all connected with the positive pole of auxiliary battery LB<sup>2</sup>, while the plates  $v^1$   $v^3$   $v^5$ , which send the current for returning the escapement-arm, are all connected with the opposite pole of the battery. Hence, in case no impulse immediately follows, the first auxiliary battery sends a current through the escapement-magnet in a direction opposite to that whose course was traced above, producing the desired effect. The auxiliary commutator always tends to perform this function, but when impulse immediately follows impulse over the main line (the breaks being relatively short, as explained,) the current from the auxiliary battery does not act, since its circuit is broken at one or the other of the relay-armatures. In case of the extra-long interval due to the omission of an impulse, the auxiliary battery has abundant time to reverse itself through the escapement-magnet and to shift switch-arm  $s$  from one plate to the next. In case of two omissions of line-impulses together, the auxiliary commutator will repeat its action. In the case where the type-wheel is already in the position to print the desired character, the combination consists of but a single impulse, the other three elements being represented by blanks or no impulses. In such case the

first impulse, which operates the shift-magnet, starts the escapement-shaft, and the auxiliary commutator works it entirely around. Thus the escapement-shaft  $p^2$  makes one complete revolution for each combination, however composed.

At the end of each revolution the circuit of the printing-magnet  $m^4$  is closed through its battery LB', through the operation of the three-point switches already referred to. I will now describe their operation: Arm  $q^3$  has two contact-strips 36 37, and arm  $q^4$  has two similar strips 38 39. Contacts 36 and 38 are connected by wire 40 and strips 37 and 39 by wire 41. A wire 35 runs from one pole of battery LB' to arm  $q^3$ , and another wire 42 runs through magnet  $m^4$  to arm  $q^4$ . In the position shown in Fig. 9 the circuit of battery LB' is open. When, however, pinion  $q$  has made a complete revolution with shaft  $p^2$ , arm  $q^3$ , turning in the direction of the arrow, will have made a semi-revolution and come into contact with strip 37. This completes a circuit, as follows: from minus pole of battery LB', by wire 35, to arm  $q^3$ , to strip 37; thence by wire 41, strip 39, arm  $q^4$ , and wire 42, through magnet  $M^4$ , back to battery LB'. The printing-shaft now operates as above described, and in doing so it turns arm  $q^4$  one-half a revolution into contact with strip 38, which is now out of circuit by virtue of the fact that its companion strip 36 is no longer in contact with arm  $q^3$ . When arm  $q^3$  makes another semi-revolution, which it does when the next signal has passed over the line, it again touches strip 36, closing the circuit of printing-magnet  $M^4$ , which is immediately broken again by the movement of printing-shaft F. Thus the switch-arms of the two three-point switches operate in alternation, one to close the circuit of the printing-magnet at each rotation of the escapement-shaft and the other to break the circuit at each rotation of the printing-shaft.

For producing the required combinations of impulses I have devised a simple form of transmitting apparatus. (Illustrated in Figs. 7 and 8 and by diagram in Fig. 9.) This transmitter is of the keyboard type, and by its operation the depression of any of the keys has the effect of sending to line from main battery MB the combination of impulses corresponding to the character which such key represents. For this purpose an ordinary commutator, comprising a switch-arm S and four plates or segments 50 51 52 53, are provided. These plates are respectively connected with the four plates 60 61 62 63 of a pole-changing apparatus, while the switch-arm S is connected to line L. Adjacent to these plates are two conducting-bars 54 55. The former connects with the positive pole of battery MB and the latter with its negative pole, while a wire 56 runs from the middle of the battery to ground. Between the bars 54 55 is an insulating-strip 57. Each contact-plate has a movable contact-maker, desig-

nated, respectively, 70717273, these being the real pole-changers. The contact-points normally bear on the insulating-strip 57 when no current goes to line. If a pole-changer is moved up a positive current goes to line through the corresponding commutator-segment; if down, a minus current. Thus it will be perceived that to properly operate the transmitter it is only necessary that the depression of a key should operate the proper combination of pole-changers and cause the switch-arm S to make one revolution.

The shaft of switch-arm S carries a pulley S', driven by a constantly-running cord which engages it with light friction. The arm is normally held from rotation by a stop-lever 65, engaging a finger 66, connected with the switch-arm. This lever 65 has a cross-bar 67 extending under all the key-levers U, so that the depression of any key releases the switch-arm, permitting it to make one revolution, sending to line a combination of four elements, the character of which depends on the positions of the four pole-changers.

The actuating mechanism for the pole-changers will be understood by reference to Figs. 7 and 8. Each key-lever U carries two uprights U' U<sup>2</sup>, each of which has projections *w* for operating the pole-changers. It will be understood that arrangement of these operating projections differs for each key. Each of the pole-changers is carried by a tilting frame T T<sup>2</sup> T<sup>3</sup>. These frames are pivoted on shaft *t* and have each two parallel horizontal cross-bars *t'* *t'*<sup>2</sup> extending across the apparatus, so as to be in the range of all the operating projections *w*. The explanation of the action of one key U will suffice for all. The key shown in elevation in Fig 8 is supposed to have been last depressed and returned by its spring. In this action the projection *w'* has depressed frame T, carrying pole-changer 70, which controls the first line-impulse, which is to actuate the shift-magnet M. Hence the first impulse is minus. Frame T' has been tilted in the opposite direction by projection *w*<sup>2</sup>, sending a plus impulse to line through commutator-strip 51. Frames T<sup>2</sup> T<sup>3</sup> have not been tilted at all, the positions of the projections *w*<sup>3</sup> *w*<sup>3</sup> and *w*<sup>4</sup> *w*<sup>4</sup> being such as merely to touch the cross-bars *t'* *t'*<sup>2</sup> of their respective frames if the latter happen to be in a horizontal position. Hence no current goes to line through pole-changers 72 73, and therefore the signal transmitted by this key consists of the elements minus, plus, zero. The projections *w*<sup>3</sup> *w*<sup>4</sup> act as restorers in case frames T<sup>2</sup> T<sup>3</sup> have been shifted by the preceding key. This obviates the necessity of providing special means for returning the frames after each key has been struck, since each key positively sets its combination of pole-changers in whatever position it may find them. The key-levers, after being depressed and released, are at once restored by their springs *y*, and not detained in their depressed condition until the commutator has

made a complete revolution. Spring-restoring mechanism for the pole-changers being dispensed with and positive setting devices substituted therefor renders it unnecessary to keep the keys depressed for a definite time, since the pole-changers will remain wherever placed until shifted by the depression of another key.

The foregoing description has set forth with minuteness the details of a system embodying the principles of the invention; but it must be understood that this is done only for the purpose of explaining fully one way in which the invention may be carried into effect and not with the object of giving undue importance to details, which may be varied and modified within wide limits.

The invention involves certain features which are believed to be broadly new, and therefore it is designed to cover them broadly. For example, no type-wheel system has heretofore been devised, so far as I am aware, in which the combinations representing different characters of the code are made up of three elements. All similar systems heretofore have utilized only the powers of two elements represented by plus and minus impulses.

The use of controlling mechanisms for the printing devices each having three functional positions is also believed to be new. This feature of the invention can be applied by one skilled in the art to mechanism widely different from that described herein.

Having thus described my invention, what I claim as new is—

1. In a telegraph system, and in combination with suitable receiving apparatus adapted to respond to signals compounded of three impulses, represented by plus impulses, minus impulses, and no-impulses, a transmitting apparatus comprising a generator, a series of pole-changers and mechanism for shifting each pole-changer to connect either pole of the generator to line, or to leave the line open, thus sending to line signals compounded of plus impulses, minus impulses, and no impulses, as set forth.

2. In a telegraph system, the combination with receiving apparatus adapted to respond to signals compounded of three elements represented by plus impulses, minus impulses, and no impulses, of transmitting apparatus comprising a commutator, pole-changers connected respectively with the successive plates of said commutator, a generator, and mechanism for operating the pole-changers to connect either pole of the generator to line through the several commutator plates, or to disconnect it, as set forth.

3. The combination with the telegraphic receiving apparatus adapted to respond to signals compounded of three elements, as specified, of a transmitter comprising a commutator, pole-changers, one for each commutator plate and adapted to assume any of three positions, a generator, and circuits and

connections whereby a pole-changer in one position connects the positive pole of the generator to its commutator plate, in the second position connects the negative pole with said plate, and in the third disconnects said generator and plate, substantially as described.

4. The combination in a telegraphic transmitter, of the commutator, the pole-changers, one for each commutator plate, carried each by a movable support, and key-levers having actuating devices, different for each lever, for positively setting all the pole-changers from whatever position, normal or otherwise they may be in, substantially as described.

5. The combination, in a telegraphic transmitter, of a commutator normally held stationary by a detent, a motor for said commutator, pole-changers, having each three functional positions, there being one pole-changer for each commutator plate, key-levers and mechanism actuated thereby for operating said pole changers and for releasing said commutator from its detent permitting it to make one revolution, as set forth.

6. In a telegraph receiver, the combination with signal-receiving devices including a shaft and means for rotating the same always in one direction, of a series of interlocking stop-mechanisms whereby the point of arrest of said shaft is determined, said stop-mechanisms comprising arms rotatable in the direction of rotation of said shaft, and electro-magnets controlling the several stop-mechanisms, substantially as described.

7. In a telegraph receiver, the combination with a non-restoring type-wheel, and means for rotating the same in one direction only, of stop-mechanism comprising a series of interlocking arms, carried each by rotatable supports, and electro-magnetic controlling devices, whereby the stops can be shifted axially to arrest the said shaft at any desired point, substantially as described.

8. In a telegraph-receiver, the combination with a shaft and means for rotating the same, of a series of interlocking and independently movable stops, having each three functional positions, and electro-magnetic mechanism, whereby the stops are independently controlled, substantially as described.

9. The combination with the type-wheel and means for rotating the same, of a series of stop-mechanisms, each comprising three stop-fingers on a rotatable support, an engaging arm on an independent support and means controlled by an electro-magnet for shifting the arm from the path of one stop into that of another, substantially as described.

10. The combination with the type-wheel and means for rotating the same, of a series of stop mechanisms, each comprising three

stop-fingers in different planes and carried by a rotatable support, an engaging arm on an independent support, and an electro-magnet and connections for shifting the arm to one position when influenced by a positive current, and to another when influenced by a negative current, said arm occupying a third position when the magnet is not excited, substantially as described.

11. The combination with the printing-wheel, having two rows of type, and the motor, of the shift-magnet for shifting the printing-wheel lengthwise of its shaft and a series of interlocking stop-mechanisms, having each a controlling magnet, whereby the point of arrest of the wheel is determined, substantially as described.

12. The combination with the printing-wheel, and motor, of a series of interlocking stop-mechanisms, for determining the arrest of the wheel, each stop-mechanism being actuated by a lever connected with the armature of a magnet, a printing shaft, printing mechanism actuated thereby, and restoring devices for said armature levers actuated from said printing shaft, substantially as described.

13. The combination with the type-wheel, a series of magnets controlling stop mechanism therefor, a commutator for bringing the stop-magnets successively into circuit with a divided local battery, an auxiliary battery, a differentially wound escapement magnet having two similar reversely wound coils in circuit respectively with the two parts of said local battery, both said coils being serially connected in the circuit of said auxiliary battery, relays in the main line responding respectively to positive and negative impulses and controlling the circuit connections of said local battery, and an auxiliary commutator in circuit with said auxiliary battery, substantially as described.

14. The combination of the type-wheel, a series of stop-magnets, mechanism controlled thereby for determining the range of movement of said wheel, a commutator to the plates of which said magnets are respectively connected, a printing magnet and mechanism controlled thereby, a switch operated by the commutator shaft to close the circuit of the printing magnet when said commutator has completed a revolution, and a second switch operated by said printing shaft to break said circuit when said shaft has completed a revolution, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JONATHAN E. WOODBRIDGE.

Witnesses:

PHILIP MAURO,  
REEVE LEWIS.