A. C. CREHORE.

PRINTING TELEGRAPH.

APPLICATION FILED AUG. 15, 1904.

969,527. Patented Sept. 6, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

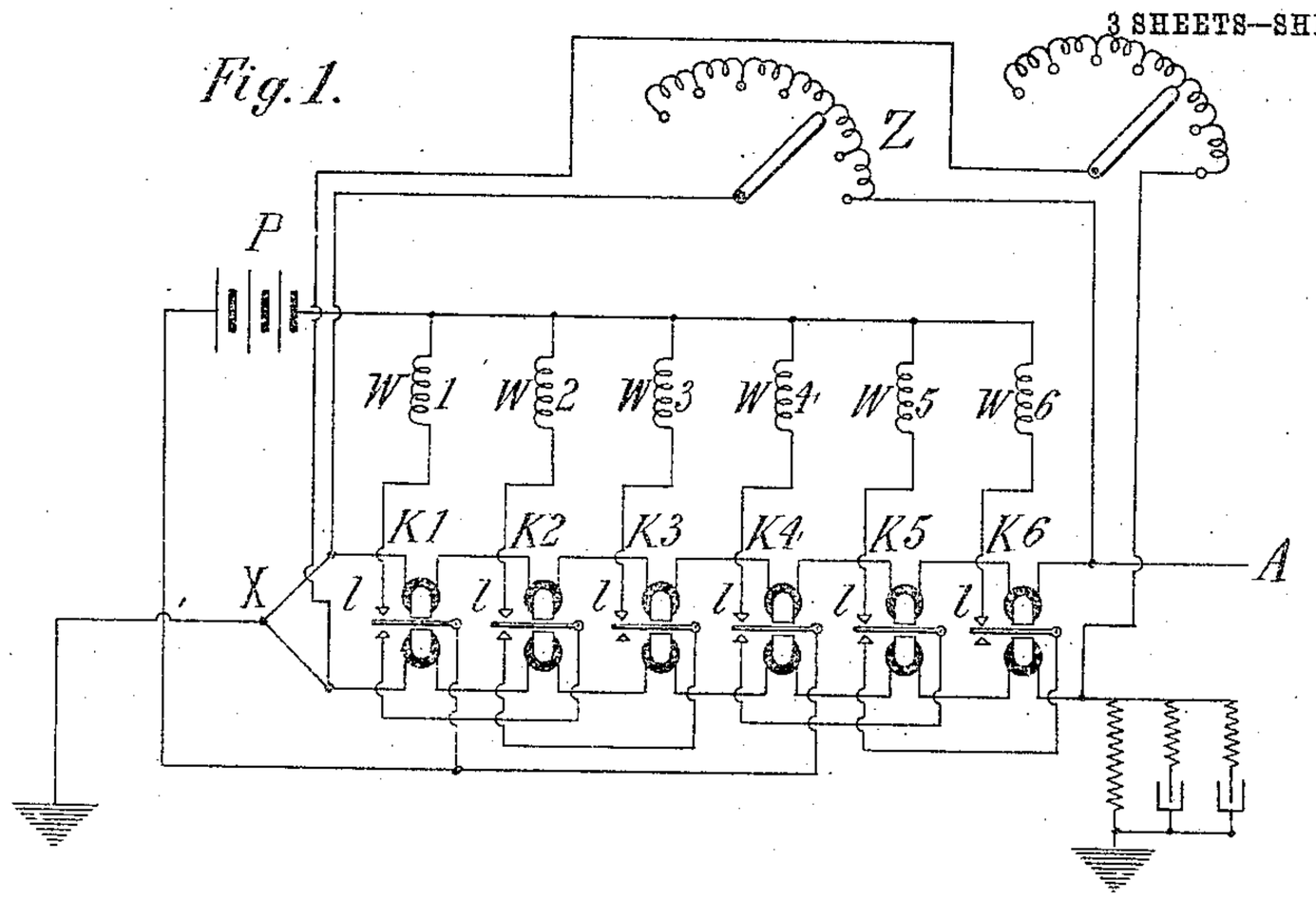
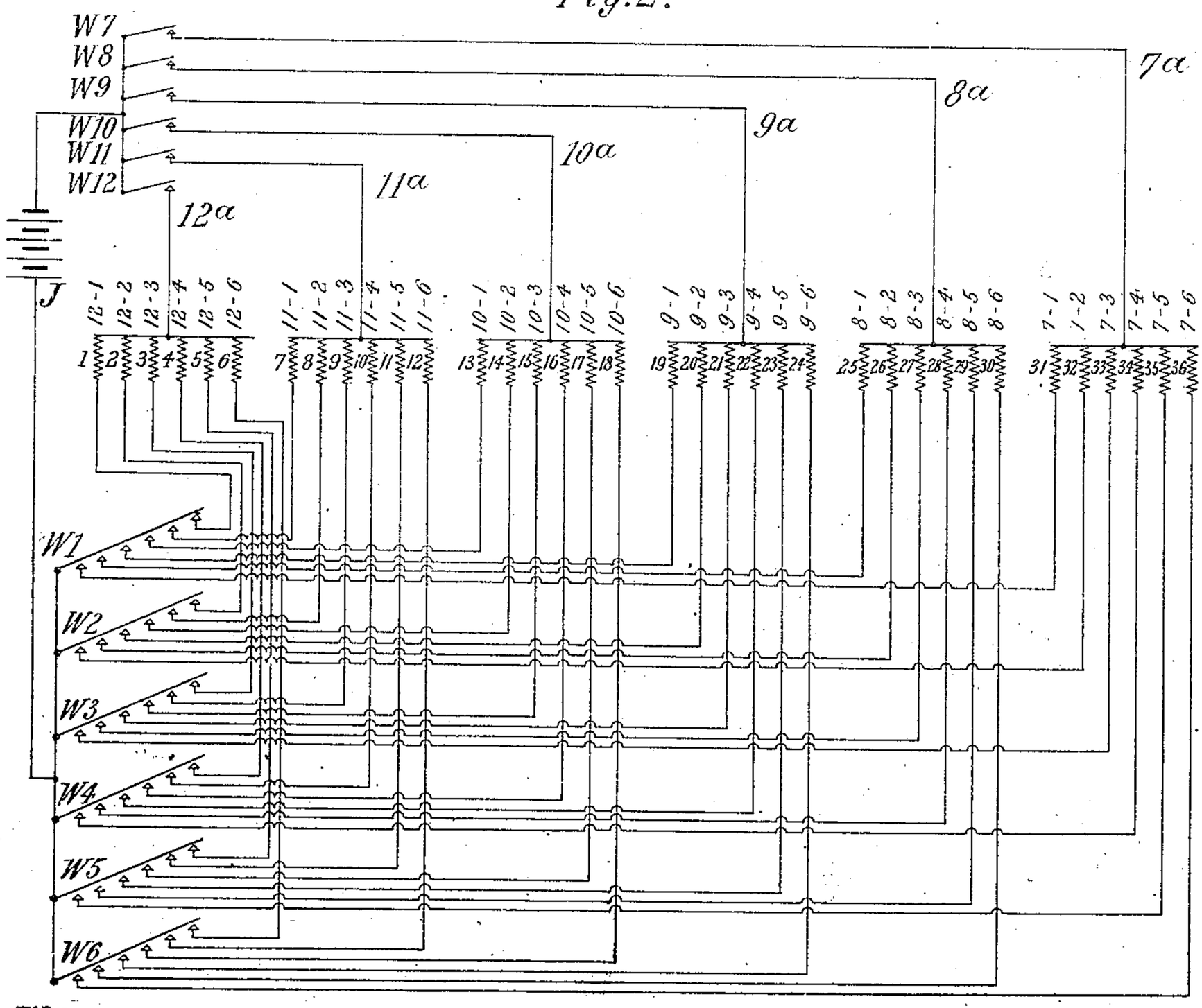


Fig. 2.



Witnesses:
Raphael Netter
L. F. Shaw

Inventor:
Albert C. Crehore
by Bently and Pierson Att'ys

A. C. CREHORE.

PRINTING TELEGRAPH.

APPLICATION FILED AUG. 15, 1904.

969,527.

Patented Sept. 6, 1910.

3 SHEETS—SHEET 2.

Fig. 3.

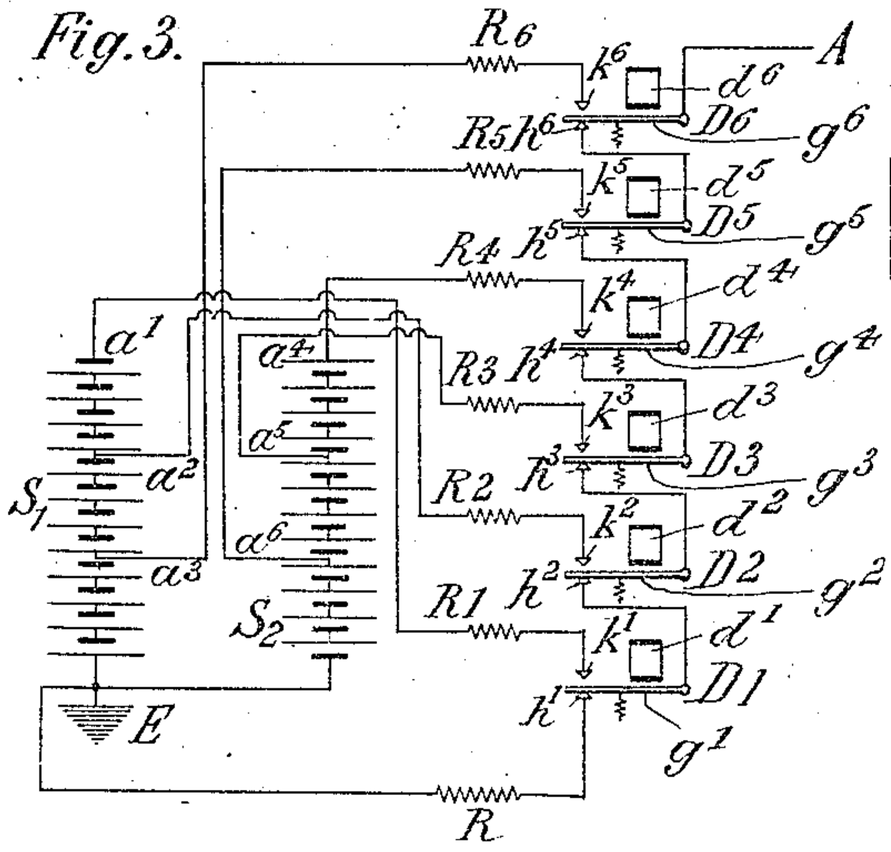


Fig. 5.

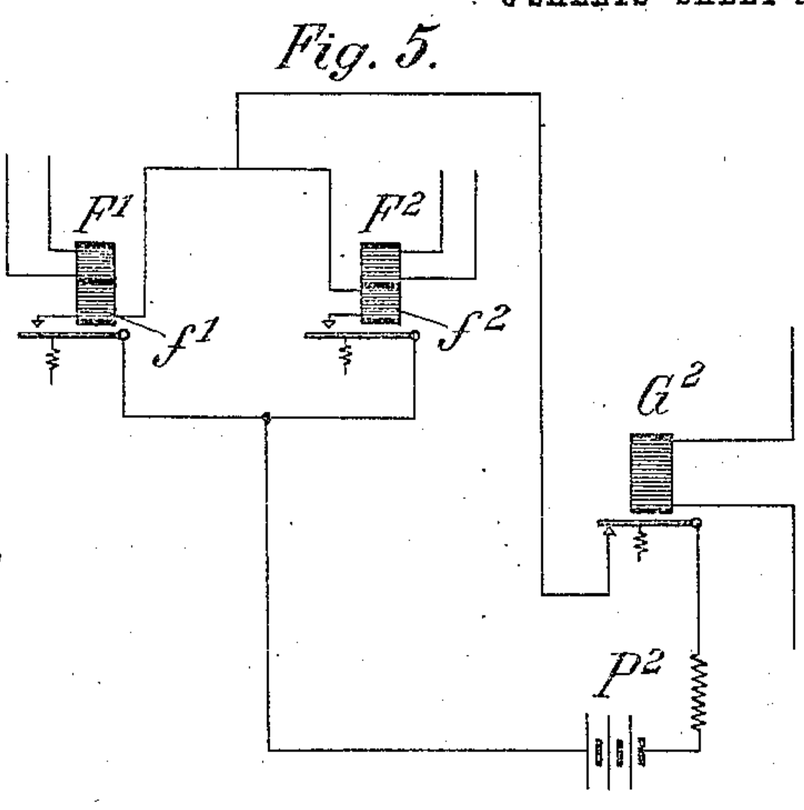
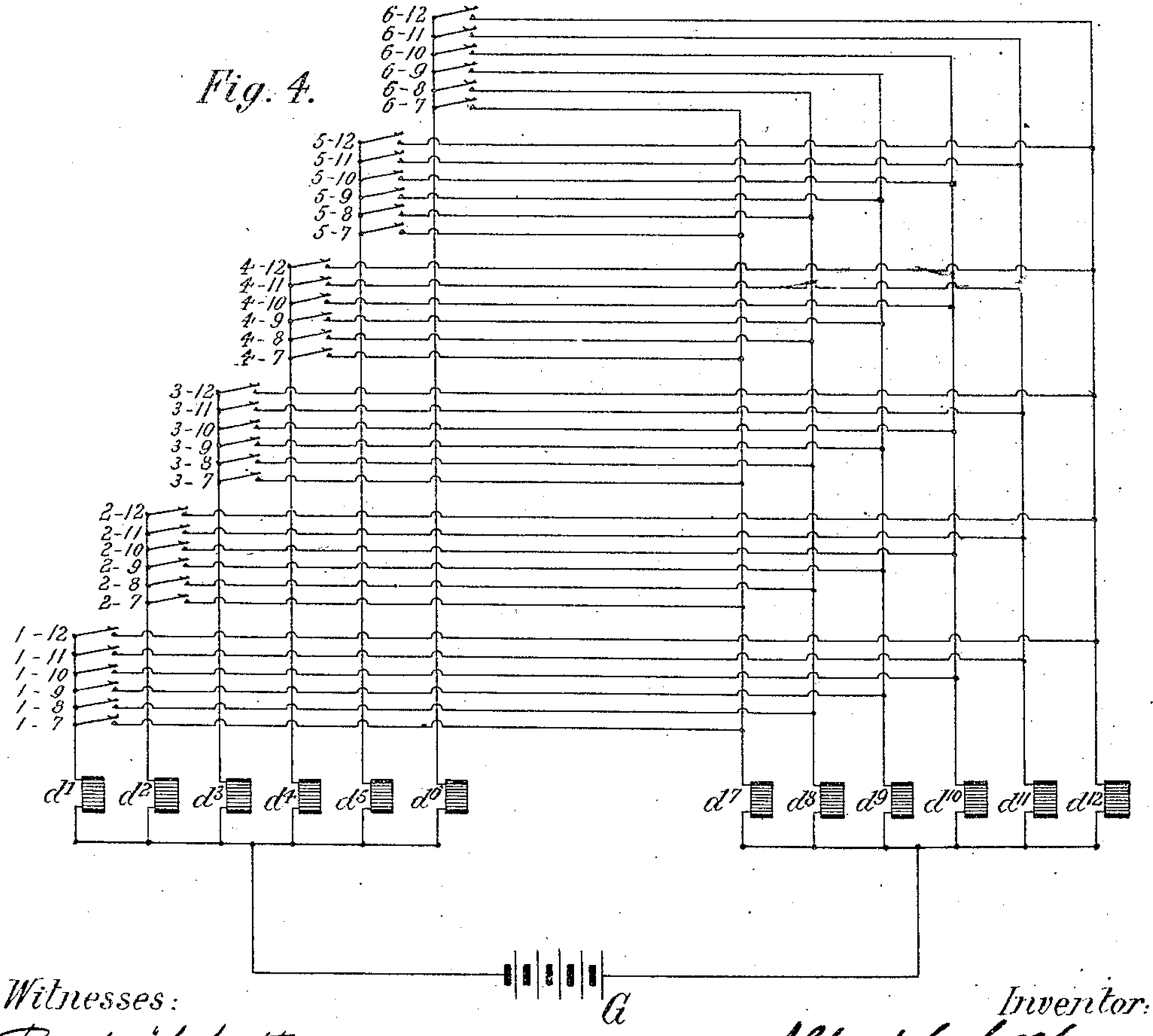


Fig. 4.



Witnesses:

Raphael Netter

L. I. Shaw

Inventor:

Albert C. Crehore

by Bartley and Pierson Att'ys

A. C. CREHORE.

PRINTING TELEGRAPH.

APPLICATION FILED AUG. 15, 1904.

969,527.

Patented Sept. 6, 1910.

3 SHEETS—SHEET 3.

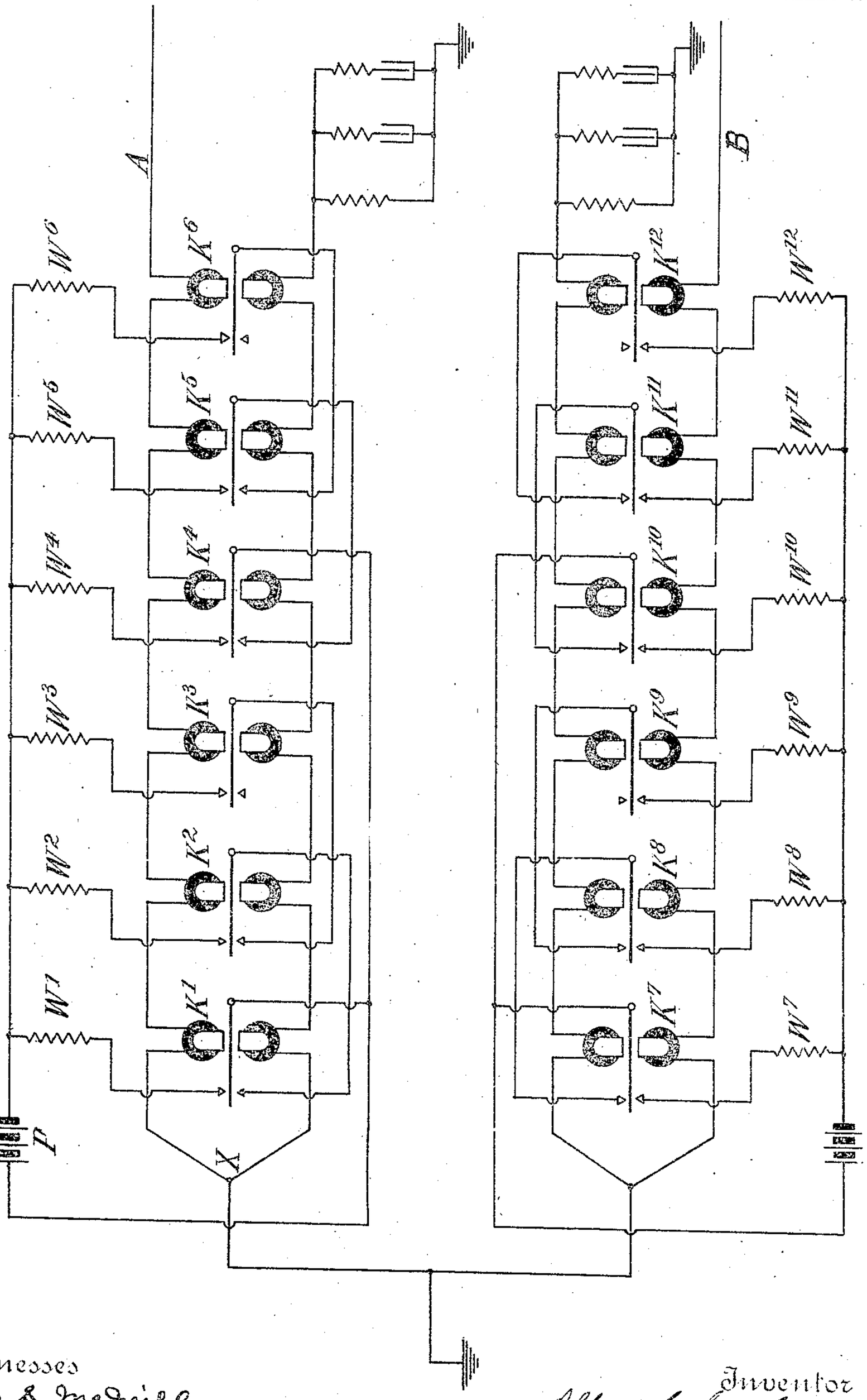


Fig. 6.

Witnesses
Alma S. McNeill
Lena A. Shaw

Inventor
Albert C. Crehore
By his Attorneys
Bentley & Rieman

UNITED STATES PATENT OFFICE.

ALBERT C. CREHORE, OF YONKERS, NEW YORK, ASSIGNOR TO TYPEWRITING TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

PRINTING-TELEGRAPH.

969,527. Specification of Letters Patent. Patented Sept. 6, 1910.

Application filed August 15, 1904. Serial No. 220,711.

To all whom it may concern:

Be it known that I, ALBERT C. CREHORE, a citizen of the United States, residing at Yonkers, county of Westchester, State of New York, have invented certain new and useful Improvements in Printing-Telegraphs; and in pursuance of the statute I have set forth in the accompanying drawing and specification, as an illustration of the invention, that form thereof which I now regard as the best one of the various forms in which the principle of the invention may be embodied.

In the drawings, Figure 1 is a diagram of the receiving relays. Fig. 2 is a circuit diagram of the printing magnets. Figs. 3 and 4 are circuit diagrams of the transmitting devices, and Fig. 5 shows a mode of locking the shift-magnets. Fig. 6 is a diagram of both lines with both transmitting and receiving apparatus.

My invention relates to a system of telegraphy in which the principal object is first, to transmit messages by means of a keyboard arranged like the keyboard of an ordinary typewriter—each button operating a circuit-closer—and second, to receive the messages in a corresponding manner on a similar typewriter, the keys being operated by electromagnets. I accordingly do not undertake, in my present disclosure, to show the details of the transmitting keyboard, but simply indicate a series of circuit closers which may, in ways well known to the art, be arranged in keyboard form with a button for each of the circuit-closers. Likewise at the receiving station I do not undertake to show the details of the receiving typewriter, but simply show a series of magnets which will, in any desired manner, operate respectively the several key levers of a typewriter, including the key levers corresponding to the several letters and characters and, in addition, suitable shift-keys for capitals and figures and a key for returning the carriage at the end of the line. Such typewriters are already known and my receiving magnets may be applied to any special form thereof in any desired manner.

By the use of the shift-keys I am able to transmit as many as ninety different characters, using three cases of thirty each, with two shift keys.

In my system it is possible to transmit two messages, one in each direction, duplexing the lines by the well known method; but it requires two line wires to transmit a single message.

My invention utilizes as its basis the plan of employing two line wires operated independently of each other, with a ground return for each. Each wire is employed to select and operate some one of six secondary relays, there being twelve such relays in all, six for each line wire, and the selection being made on each line by three currents of different strengths, each working in two directions. No two of the set of six secondary relays operated over one wire can be operated simultaneously, but any one of them may be selected and operated by the transmitting operator. Since the two line wires are independent, any one secondary relay of the set of six belonging to one line may be operated simultaneously with any one of the six belonging to the other line, and by operating a single secondary relay only on each of the two lines there are $6\times6=36$ different combinations of the 12 secondary relays which may be made. Each of these 36 combinations is utilized to control an individual magnet, and it will thus be evident that, since it requires a single operation only, over each line wire, to operate a printing-magnet, we have a system in which a single current impulse only, over each wire, is required for each character transmitted. It thus appears that for a series of receiving magnets thirty-six in number, there is provided, for the control of each magnet, but twelve relays in all, and the relays are thus less in number than the receiving magnets controlled thereby. Moreover, out of the group of twelve relays a specified portion thereof, which I term a fractional group, act in the selection of any individual receiving magnet. In addition the fractional groups corresponding to the respective receiving magnets contain each the same number of relays. For example, out of the entire group of twelve relays each fractional group will contain two relays and there are available in all thirty-six fractional groups, each containing two relays and each corresponding to one of the thirty-six receiving magnets. This same general principle may be employed with larger fractional groups, provided in each case all of the fractional groups contain the same number of relays. By means of this arrangement I not only

secure a large number of selections with a comparatively small number of relays, but in addition I greatly simplify the operation by the uniformity in the number of relays contained in the fractional groups.

Referring to the drawings Fig. 1 shows in diagram the receiving part of one of the line wires A as arranged for duplex working. The second line B will be arranged in identically the same way and I have so shown it in Fig. 6, but have given the several parts thereof numbers from 7 to 12 inclusive where they are numbered from 1 to 6 inclusive in Fig. 1 which illustrates the line A. K^1, K^2,—K^6 are six differentially wound polar relays connected in series (they may be if desired in parallel or series parallel) one half of the windings being in the line side and the other in the artificial line side, each half being connected to ground through the apex X. Each relay armature is held by a spring (or by its magnetic bias) against its back stop when no current flows over the line, which is the normal position when not working. Three of the six relays, viz: K^1, K^2 and K^3 are connected in the proper sense so that a large positive current coming in from line to ground will operate each of them moving the three tongues over to the respective front stops 1, 1, 1. The other three relays K^4, K^5, K^6 are connected in the opposite sense so that a negative current going out from ground to line will operate them. The positive current will then merely hold these three relay armatures K^4, K^5, and K^6 more firmly against their back stops. In addition to this difference in the sense of the relays, the relays K^1 K^2 and K^3 are wound and adjusted to respond to different magnitudes of received current. To the smallest positive current, only relay K^3 will respond; but to the next size of current both K^3 and K^2 will respond, while to the third size or largest current all three of the relays K^1, K^2 and K^3 will respond.

It will be noted that the armatures of relays K^1 and K^2, K^4 and K^5, are provided with both front and back contacts while K^3 and K^6 have front contacts only, and that the back contact of K^1 is connected with the lever of K^2, the back contact of K^2 to the lever of K^3, and similarly the back contact of K^4 is connected to the lever of K^5, and the back contact of K^5 to the lever of K^6. These relays might operate the circuit closers of the several receiving magnets directly, just as the relay of an ordinary Morse telegraph operates directly upon the circuit of the sounder, but I prefer to introduce an intermediate set of secondary relays as shown in Fig. 1, for the customary purpose of reinforcing the power of the main relays. The front contact of the six relays, K^1—K^6 are respectively connected to six secondary relay magnets W^1, W^2—W^6 and all the opposite terminals of these secondary relays connected to local battery P. The levers of relays K^1 and K^4 are connected to the opposite terminal of battery P. By this disposition of the local circuits it is seen that if a small positive current is received over the line moving the armature of K^3 alone to its front stop, there is a local circuit established from front stop l of K^3 to secondary relay W^3, to battery P, to lever of K^1 thence to back stop of K^1 and lever of K^2, to back stop of K^2 and lever of K^3 and return to front stop of K^3; and the current in this circuit operates secondary relay W^3 only.

If an intermediate positive current is received operating both relays K^2 and K^3 the secondary relay W^2 only will receive current and operate. The path of the local current is from battery P to lever of K^1, to lever of K^2, to front stop l of K^2, to secondary relay W^2 and thence to battery. This current operates secondary relay W^2. The circuit of secondary relay W^3 is now open however and inoperative even though its relay armature K^3 is against its front stop l. The circuit from secondary relay W^3 passing through the front stop l and lever of K^3 is open at the back stop of K^2 whose lever is now against its front stop l. Similarly, if a large positive current is received operating all three of the relays K^1, K^2 and K^3 simultaneously, the secondary relay W^1 is the only one which will respond; for the circuits of W^2 and W^3 are open at the back stops of K^1 and K^2; and the circuit of W^1 is closed. Hence we may select any one of the three secondary relays W^1 W^2 W^3 by sending over the line a large, intermediate, or small positive current; and similarly we may select any one of the three secondary relays W^4, W^5, W^6 by sending over the line a large, intermediate, or small negative current. A single impulse sent over the wire suffices to select and operate any one of the six secondary relays over one line wire A.

By duplicating the apparatus shown in Fig. 1 a second group of secondary relays which may be referred to as W^7—W^{12} may be operated over a second line wire, which may be referred to as line B and which is illustrated in Fig. 6.

Fig. 2 illustrates one method of selecting any one of a group of 36 magnets by means of the contacts controlled by the twelve secondary relays. The several printing magnets are numbered and also marked by the combination of the two secondary relays which control them respectively. Thus the first printing magnet 12—1, printing, say letter P, will be controlled by the secondary relays W^{12} operating over line B, and W^1, operating over line A. The secondary relays W^1—W^6, operating on line A, each have

six independent contacts, and relays W^7—W^{12}, operating on line B, each require a single contact only. It is evident from the diagram that the only path for current to pass from the battery J when W^{12} and W^1 are closed is through magnet 12—1; for the magnets 7—36 can receive no current, since their circuits are open at the contacts W^7—W^{11} leading to the respective magnet groups 7^a, 8^a, 9^a, 10^a, and 11^a. The magnets 2—6 receive no current, since one terminal of each is open at contacts of the secondary relays W^2, W^3, W^4, W^5, and W^6. In a similar manner any other one of the 36 printing magnets might be selected, by closing the proper pair of secondary relays, one from the group W^1 to W^6 and the other from the group W^7—W^{12}.

It remains to be explained how some one of six different kinds of current can be transmitted simultaneously over each line wire in order to select one of the thirty-six printing magnets; the required currents being the three values of positive current and the three values of negative current.

Referring to Fig. 3, S^1 and S^2 represent two grounded batteries,—or one large battery grounded at its middle point—so that one battery S^1, will send positive current and the other S^2 negative current to line. D^1—D^6 represent six separate circuit closers having g^1—g^6 with both front (k^1—k^6) and back (h^1—h^6) contacts. The levers are held by springs in contact with the back contacts h^1—h^6 which is the normal position. When in this position there is a completed circuit from line to ground through the back contacts of the six circuit closers in series and through the resistance R which is inserted so as not to disturb the balance in duplex working. This circuit is from line A to lever g^6 of circuit closer D^6, to back contact h^6 and thence to lever g^5; back contact h^5, lever g^4 etc., until we reach resistance R and ground E. The normal condition is therefore line grounded and batteries open. Now let lever g^1 be operated and move from its back stop h^1 to its front stop k^1. The path through resistance R from line to ground is thus opened at h^1, and the circuit is now completed from line through the back contacts of the five circuit closers D^2—D^6 as before, and thence to k^1 and protective resistance R^1, to a^1 and through the whole positive battery S^1 to ground E. In a similar manner if the lever g^2 of circuit closer D^2 is the only one of the six to be operated, the path to ground through resistance R is opened at its back stop h^2, and positive battery of an intermediate value is connected to line through front stop k^2 resistance R^2 and circuit a^2 through a portion of positive battery S^1 and ground E. In a similar manner lever g^3 of circuit closer D^3 sends the smallest positive current to line. D^4 sends the largest negative current and D^5 the intermediate negative current, and D^6 the smallest negative current. By supplying for the duplicate arrangement on line B, six other circuit closers D^7—D^{12} and connecting them to the same batteries S^1 and S^2 of Fig. 3 in a manner precisely similar to the diagram of Fig. 3 the second line wire B may be made to receive in like manner any one of six kinds of current for operating the set of six secondary relays W^7—W^{12} as already described. These circuit closers D^1—D^{12} might be operated by hand, in which case it would be necessary for the operator to learn which combinations correspond to particular characters. A better plan is to provide twelve electromagnets one to control each circuit closer and operate these electromagnets from a keyboard. In Fig. 4 I have shown such an arrangement. In this drawing d^1—d^{12} represent the coils of twelve magnets which control respectively the twelve circuit closers D^1—D^{12}, six of which are shown in Fig. 3.

There are represented in Fig. 4 thirty-six button circuit closers, each corresponding to a certain key lever of the receiving typewriter. These circuit closers are numbered, in a similar manner to the printing magnets of Fig. 2, according to the combination of transmitters which they control. Thus 1—12 denotes the key for transmitting—say the letter "P," and controls both circuit closers D^1 and D^{12} simultaneously, the current from local battery G passing through both coils d^1 and d^{12} in series whenever the key 1—12 is closed. Moreover the only path established for current by closing 1—12 is through magnets d^1 and d^{12}, all of the other magnets d^2—d^{11} remaining on open circuit, as an inspection of the diagram makes evident. These thirty-six circuit closers may be arranged in the form of a keyboard convenient for an operator; or they may be attached to the keys of a typewriter similar to the receiving typewriter, so that the transmitting operator sees the record printed on the home transmitting typewriter and makes an exact duplicate of that made by the receiving typewriter.

If a keyboard only is provided instead of a transmitting typewriter, there is an additional requirement to provide means of warning the operator of the approach of the receiving typewriter to the end of the line when the carriage must be returned. This may easily be arranged by providing a counter attachment to the transmitting keyboard which will ring a bell or give suitable warning after the operator has depressed a fixed number of keys, just as in an ordinary typewriter.

Having described the separate parts of the apparatus, which go to make up the whole printing system, we will now follow through the operation of transmitting one character,

say the letter "S," from the time the transmitting operator transmits it, until it is received and the apparatus restored into condition to receive the next letter. Suppose that the key 1—11 Fig. 4 corresponds to the letter "S". The operator depresses this key and simultaneously operates the two transmitters D^1 and D^{11}. The lever g^1 (Fig. 3) moves into contact with front stop k^1 and leaves the back stop h^1. This operation puts the largest positive current from battery S^1 on the line A. In a similar manner transmitter D^{11} (corresponding to D^5 for line A) moves its lever to its front stop and puts an intermediate negative current from battery S^2 on line B (not shown in the drawings). The current on line A operates the three relays K^1, K^2, and K^3 moving the armatures to the front stop l, Fig. 1, but holds the armatures of K^4 K^5 and K^6 more firmly against the back stops. The only circuit established through the local battery P is through secondary relay W^1 all the other five remaining open. Similarly on line B relays K^{10} and K^{11} will be operated by the intermediate negative current (corresponding to K^4 and K^5 on line A) and the secondary relay W^{11} will be the only one of the set W^7—W^{12} which is operated. Secondary relay W^{11} closes the single local contact (Fig. 2) connecting with wire leading to group 11^a including the set of six printing magnets 7—12, and, at the same time, secondary relay W^1 closes the six contacts leading to six printing magnets (one in each of the several groups 7^a—12^a) numbered 1, 7, 13, 19, 25 and 31. The printing magnet No. 7 also marked with the combination 11—1 is the only one common to the two groups, and the only one which will be operated; and this magnet depresses the typewriter key thus printing the letter "S" as would be the case if the operator depressed this same key with the finger. The printing magnet 7 will remain excited as long as the transmitting operator continues to hold down the key (1—11 Fig. 4). As soon as he releases this key, the various transmitter relays and secondary relays involved are immediately restored by their retractable springs, and the system is ready for the next character to be transmitted.

Of the several printing magnets, which may thus be selected and operated, one will operate the spacing key, another will move the carriage to the left, another will move the carriage to the right and three will be devoted to the shifts, one working the "Cap"-shift, a second working the "Fig."-shift and a third releasing the shifts after the desired number of "Caps" or "Figs." have been printed. The shift mechanism on the receiving machine may be locked automatically, when operated, in any desired way and remain so till released by the releasing magnet. One mode is shown in Fig. 5, wherein the "Cap" shift-magnet F^1, and the "Fig." shift-magnet F^2 are each provided with a retaining coil, f^1 and f^2 in the circuit of battery P^2, these coils being automatically energized whenever their respective magnets F^1 or F^2 act, and remaining energized until the circuit of battery P^2 is broken by release magnet G^2.

It will be evident that in the use of three different current values, any large leakage on the line will tend to cause trouble by reducing the current strength of a large value to the lower value of the next smaller current. This may be compensated for by readjusting the several relays to a lower power while still retaining the same ratio of power between them, or it may be compensated for by increasing the electric pressure at the sending station. I prefer however, to shunt the receiving relays by an adjustable resistance Z, Fig. 1, so that an adjustable portion of the current will pass through the shunt and by increasing or decreasing its resistance a larger or smaller portion of the current may be diverted into the relays.

It is to be understood that my invention may be embodied in various specific forms by one familiar with the art.

In Fig. 6, I have shown an assemblage diagram of the apparatus on both lines which will be readily understood from the description already given. I will also add that while it is much preferable to employ the secondary relays, yet it is only the 12 main line relays which are relied upon for selecting and, if desired, operating the individual magnets to be operated. By combining these 12 relays in groups of two, (on my general principle of combining a given number of relays in fractional groups, each group containing the same number of relays,) I am enabled to utilize the entire selective capacity of the relays in a simple manner. By means of this principle I can secure a maximum number of combinations with a minimum number of relays. From another point of view it may be said that the number of relays in each set is equal to the square root of the number of receiving magnets controlled thereby. Thus, each of the six relays in one set combines with first one and then another of the six relays in the other set, until it has coöperated in turn with each of the six, making a selection of some one receiving magnet at each coöperation. Each of the six in one set thus cooperating in turn with each of the six in the other set give us six times six, or 36 selections. The same is true of the relation between the 12 relays and the 36 transmitting keys at the sending station. Each key, by controlling two contacts, selects two relays at the receiving station, one from each

set and there being, as described, 36 possible combinations of the 12 relays in groups of two, there will be 36 keys, the number of keys being equal to the square of the number of relays in each relay set.

What I claim as new and desire to secure by Letters Patent, is:

1. In a telegraph system, the combination with a series of receiving magnets, of controlling relays therefor of which a plurality are included in the same line circuit and of which the number is less than the number of said magnets, each of the magnets being controlled by a fractional group of the relays independently of the controlling contact of the remaining relays and each of the said fractional groups containing the same number of relays, and means for simultaneously energizing from a distant station the relays contained in any one of the said fractional groups.

2. In a telegraph system, the combination with a series of receiving magnets, of a series of controlling relays therefor less in number than the said magnets, each magnet being controlled by a fractional group of the said relays independently of the controlling contacts of the remaining relays and each of the said fractional groups containing the same number of relays, together with two line wires and means for simultaneously energizing from a distant station the relays composing any one of said fractional groups a part of the component relays of each fractional group being energized over one line wire and another part over the second line wire.

3. In a telegraph system, the combination with a series of receiving magnets, of a series of controlling relays therefor less in number than the said magnets, each of the said magnets being controlled by a fractional group of said relays independently of the controlling contacts of the remaining relays and each fractional group containing the same number of relays, two line wires, each containing a portion of said relays and means for energizing the relays from a distant station by currents of a different and distinctive value transmitted over each of said line wires.

4. In a telegraph system, the combination of receiving magnets, a series of relays less in number than the said magnets, each magnet being controlled by a fractional group of relays, and each of the respective groups containing the same number of relays, two line wires, each containing a number of said relays and means for individually operating the said relays from a distant station by currents of distinctive values and distinctive polarities.

5. In a telegraph system, the combination with a series of receiving magnets, of two sets of relays contained respectively in separate line circuits, a local circuit for each of said magnets and two circuit closers in series in each of said local circuits, the said circuit closers controlling the said circuits and operated respectively by two relays one from each of the two sets aforesaid.

6. In a telegraph system, the combination with a series of receiving magnets, of two sets of relays included respectively in separate lines and operated by distinctive circuits, a local circuit for each of said magnets, and two circuit closers in series in each of the said local circuits, the said circuit closers controlling the local circuit in which they are contained and being operated respectively by two relays one from each of the two sets aforesaid.

7. In a telegraph system, the combination with a series of receiving magnets of local circuits for said magnets respectively, each local circuit containing and controlled by two circuit closers in series, and a series of relays less in number than the said magnets operated by distinctive currents and each group of two of the said relays controlling respectively the said circuit closers in one of the several local circuits of the receiving magnets independently of the controlling contacts of the remaining relays.

8. In a telegraph system, the combination with two line wires, of a series of relays contained in each line wire and responding to currents of distinctive value, local circuits controlled by each of the said relays, the local circuit controlled by a weaker relay being also controlled by a more powerful relay, and a series of receiving magnets, each having a local circuit controlled by two relays, one in each of the said series.

9. In a telegraph system, the combination with a series of magnets divided into groups, of a series of controlling relays therefor less in number than the magnets, and circuit closers operated thereby, each magnet being controlled by a fractional group of the said relays independently of the controlling contacts of the remaining relays and each of the respective fractional groups containing two relays, one of the two controlling a group of said receiving magnets and the other controlling one of the individual magnets in said group.

10. In a telegraph system, the combination of a series of receiving magnets, two sets of receiving relays, each set being contained in a separate line circuit and being less in number than the said magnets, and two circuit closers operated respectively by relays in the two sets, one circuit closer controlling a group of the said receiving relays and the other controlling one of the individual magnets in the group.

11. In a telegraph system, the combination with two sets of relays contained respectively in different line circuits and op-

erated by distinctive currents of a series of local circuits, each containing a receiving magnet controlled by two circuit closers in series operated respectively by two relays one from each of the aforesaid two sets, the circuit controlled by a weaker relay being also controlled by a more powerful relay.

12. In a telegraph system, the combination of a series of receiving magnets, a series of relays less in number than the magnets and divided into groups of two, each group controlling one of the said series of magnets, means for operating the said magnets by currents of different values, and a shunt around the said relays containing an adjustable resistance.

13. In a telegraph system, the combination with a series of receiving magnets, of controlling relays therefor of which a plurality are included in the same line circuit and of which the number is less than the number of said magnets, each magnet being controlled by a group of two relays independently of the controlling contact of the remaining relays, and a series of transmitting circuit closers each controlling a pair of the said relays.

14. In a telegraph system, the combination with a series of receiving magnets, of a series of receiving relays responding to distinctive currents, a series of local circuits for the respective magnets, two circuit closers in each of the said local circuits operated respectively by two of the said relays, and controlling one of the receiving magnets independently of the controlling contacts of the remaining relays and a series of transmitting circuit closers corresponding to the receiving magnets and each controlling a different pair of said relays by currents of distinctive value and polarity.

15. In a telegraph system, the combination with a series of receiving relays responding respectively to currents of different value, of a line wire, and transmitting devices comprising a series of electric generators of different values, a circuit-closer connecting each of said generators to the said line wire, and a ground connection for the line wire at the transmitting station adapted to be broken automatically by the operation of said circuit closer.

16. In a telegraph system, the combination with a series of receiving relays responding respectively to currents of different values, of a line wire containing said relays, a series of generators, a series of circuit-closers corresponding to the said generators for connecting them to the said line wire, and a ground connection for the line wire passing through the said circuit closers in series, whereby the operation of any one of the circuit closers will break the said ground connection.

17. In a telegraph system, the combination with a series of receiving relays responding respectively to currents of different value, of a line wire containing the said relays, a series of electric generators giving currents of different values, a normally open connection from each generator containing a resistance, a circuit closer for each generator for connecting it to the line wire through its respective resistance, and a ground connection for the line wire containing a resistance and controlled by each of the said circuit closers.

18. In a telegraph system, the combination with a series of receiving magnets, of local circuits therefor, a series of relays less in number than the magnets, circuit closers in series in the local circuit of each receiving magnet simultaneously operated by a fractional group of the said relays, a locking device for one or more of the said magnets, and a release for said locking device controlled by another of said magnets.

19. In a telegraph system, the combination with a series of receiving magnets, of a series of receiving relays less in number than the magnets, circuit closers in series in the circuit of each magnet, and a retaining coil on one or more special magnets of the said series of receiving magnets, the said retaining coil being controlled by another of said magnets.

20. In a telegraph system, the combination with a series of receiving magnets, of a series of relays less in number than the receiving magnets and responding in fractional groups to distinctive currents, circuit closers in the circuit of each magnet operated simultaneously by each fractional group of relays, a line wire, a series of generators giving currents of different value, a series of transmitting circuit closers, an operating magnet for each circuit closer, and a series of transmitting keys each controlling a fractional group of said operating magnets.

21. A telegraph system comprising the combination of two sets of six relays each, two line wires each containing one of said sets, a plurality of receiving magnets each having its circuit controlled by two circuit closers in series operated respectively by two relays one from each of the two sets aforesaid, and means for selecting and operating a relay from each set by a single current impulse on each line wire transmitted simultaneously from a sending station.

22. A telegraph system comprising the combination of two line wires, receiving relays in series on each line wire, means for operating any selected one of the relays upon each line wire independently of the remaining relays, and a series of receiving

magnets each controlled individually by a predetermined pair of relays so selected.

23. A telegraph system comprising the combination of a series of selecting relays of which a plurality are included in the same line circuit, a series of receiving magnets greater in number than the said relays, each magnet being controlled by a fractional group of said selecting relays and each fractional group containing the same number of relays, together with means for energizing from a distant station the relays composing any one of said fractional groups.

24. A telegraph system comprising in combination main line relays, a plurality of receiving magnets greater in number than the said relays and connected in groups equal in number to one half the number of said relays, the groups being in multiple arc with one another and the individual magnets being also in multiple arc with one another in each group, circuit closers for the individual magnets respectively, circuit closers for the respective groups, two secondary relays, one operating a group circuit closer and the other operating a plurality of individual circuit closers one from each group, and means for energizing the secondary relays by the operation in the fractional group of said main line relays.

25. A telegraph system comprising the combination of a plurality of receiving relays, a plurality of receiving magnets divided into groups, a local generator, a plurality of contacts connected in multiple to one terminal of the generator each contact being controlled by a relay and controlling a group of said receiving magnets, a plurality of contacts connected in multiple to the opposite terminal each controlled by a relay and controlling a plurality of individual receiving magnets from different groups, and means for selecting the said controlling relays in pairs from a sending station.

26. In a telegraph system, the combination with a local generator at a receiving station, of a plurality of contacts connected in multiple arc to each generator terminal, the contacts on one side controlling groups of receiving magnets, while those on the other side control each a plurality of individual receiving magnets from different groups, and relays operating in pairs to close the contacts on opposite sides of said generator respectively.

27. In a telegraph system the combination with a set of transmitting keys each having a single pair of contacts, of two sets of magnets at the receiving station, each set having magnets equal in number to the square root of the number of said keys, and means for selecting and operating a single one from each of said sets of magnets by the operation of one of said keys.

28. In a telegraph system the combination with a set of thirty-six transmitting keys each having a single pair of contacts, of two sets of magnets at the receiving station, each set consisting of six magnets, and means for selecting and operating a single one from each of said sets of magnets by the operation of one of said keys.

29. In a telegraph system, the combination with a series of receiving magnets of two sets of relay magnets controlling the said receiving magnets, each set of relay magnets being equal in number to the square root of the number of receiving magnets, and means for selecting and operating one of the said receiving magnets by the operation of two relay magnets, one from each of the aforesaid two sets of relay magnets independently of the controlling contacts of the remaining relays.

30. In a telegraph system, the combination with thirty-six receiving magnets of two sets of controlling relay magnets therefor, each set containing six magnets, and means for selecting and operating one of the said thirty-six receiving magnets by two relay magnets, one from each of the aforesaid two sets independently of the selecting and operating devices of the remaining relays.

31. In a telegraph system, the combination on one line of six line relays, means in circuit with said relays for providing positive and negative currents of three different values to operate the relays, a set of six secondary relays controlled respectively by said line relays, and recording mechanism controlled by said secondary relays.

In witness whereof I have hereunto set my hand before two subscribing witnesses, this 10th day of August, 1904.

ALBERT C. CREHORE.

Witnesses:
G. W. HOPKINS.
L. T. SHAW.