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W. H. COOLEY.

ELECTRIC TELEGRAPH.

No. 551,948. Patented Dec. 24, 1895.

Figure 1

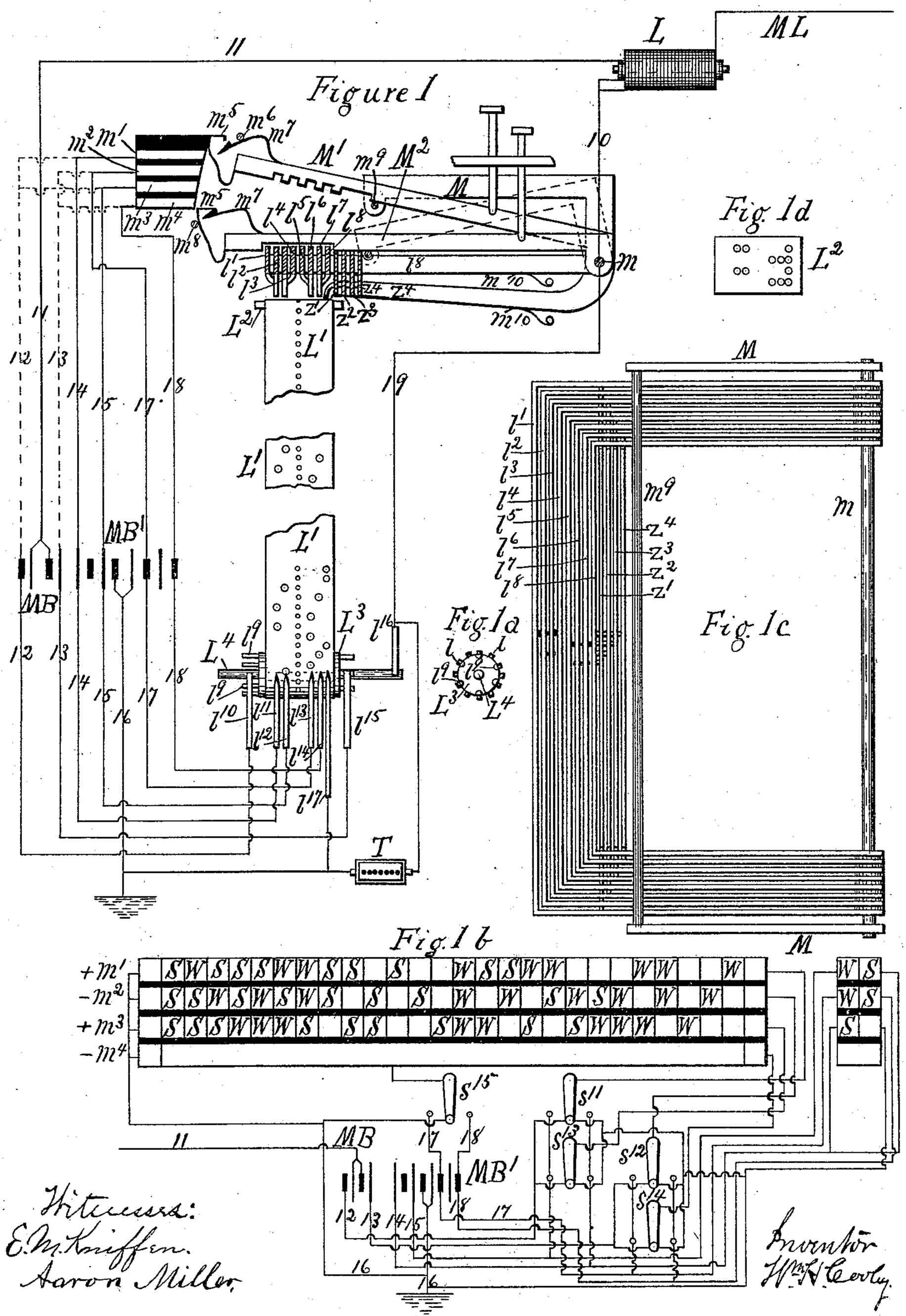

Fig. 1d

Fig. 1a

Fig. 1c

Fig. 1b

Witnesses:
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(No Model.) 10 Sheets—Sheet 2.

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ELECTRIC TELEGRAPH.

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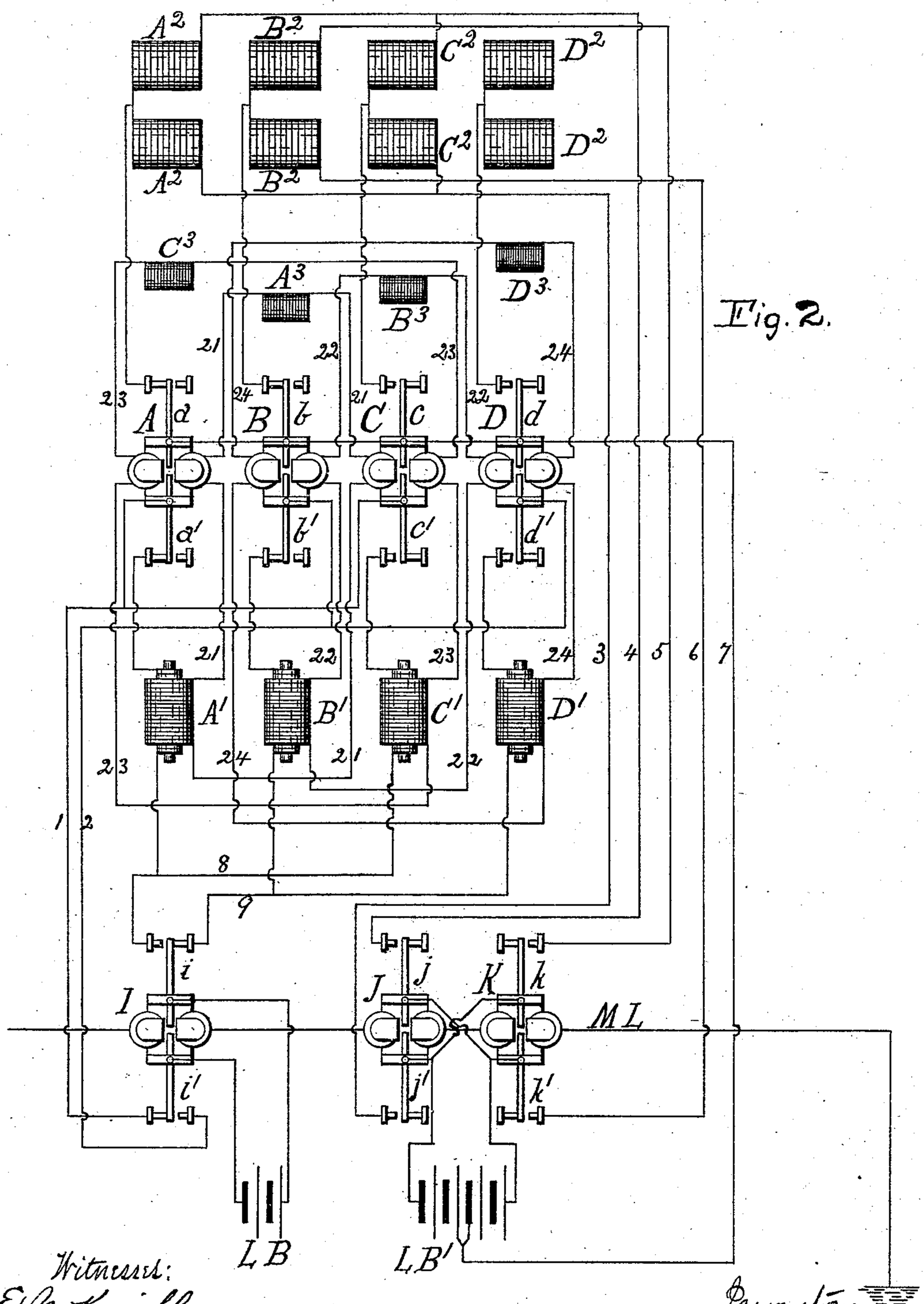

Fig. 2.

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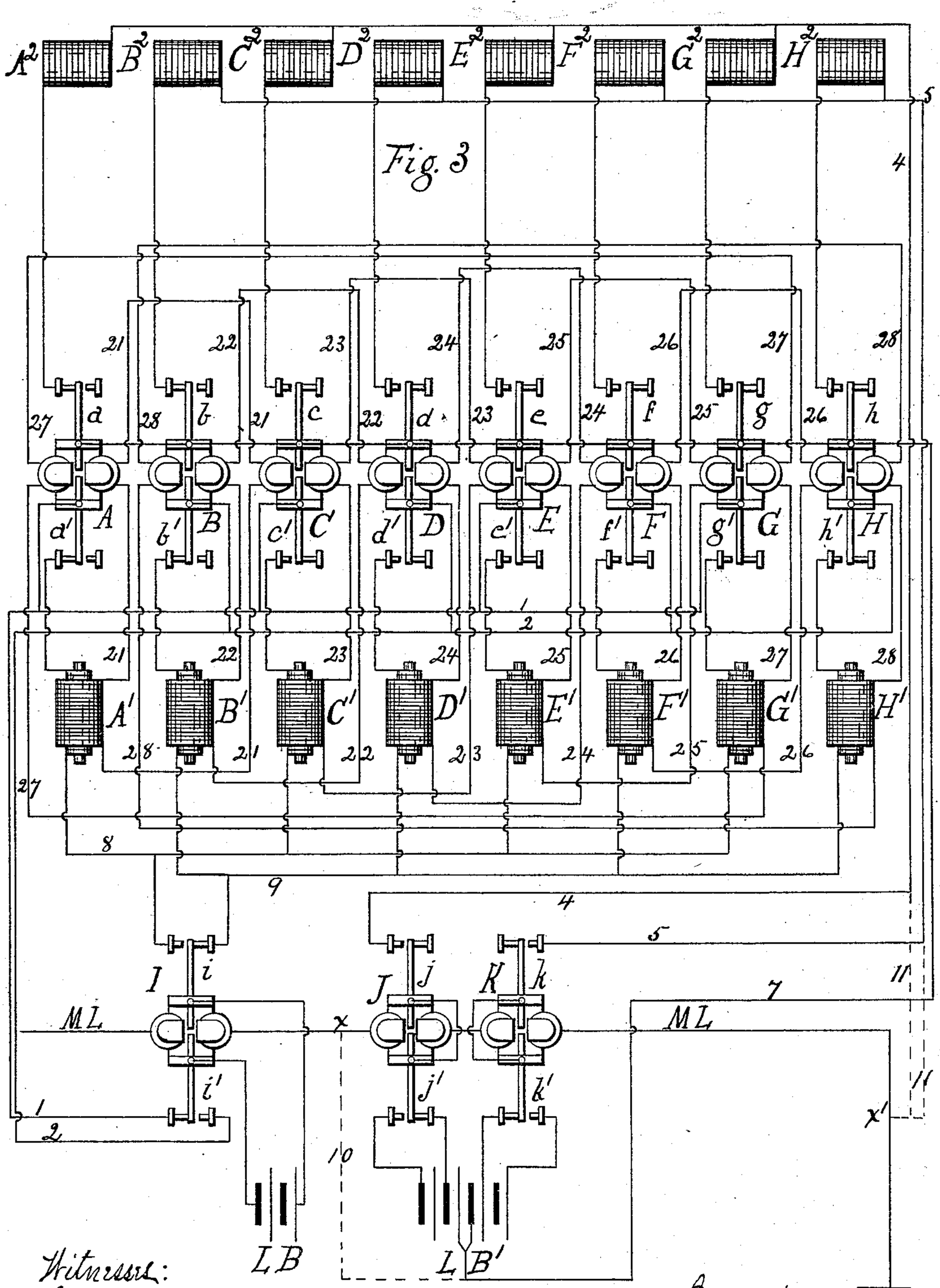
ELECTRIC TELEGRAPH.

No. 551,948. Patented Dec. 24, 1895.

Fig. 3



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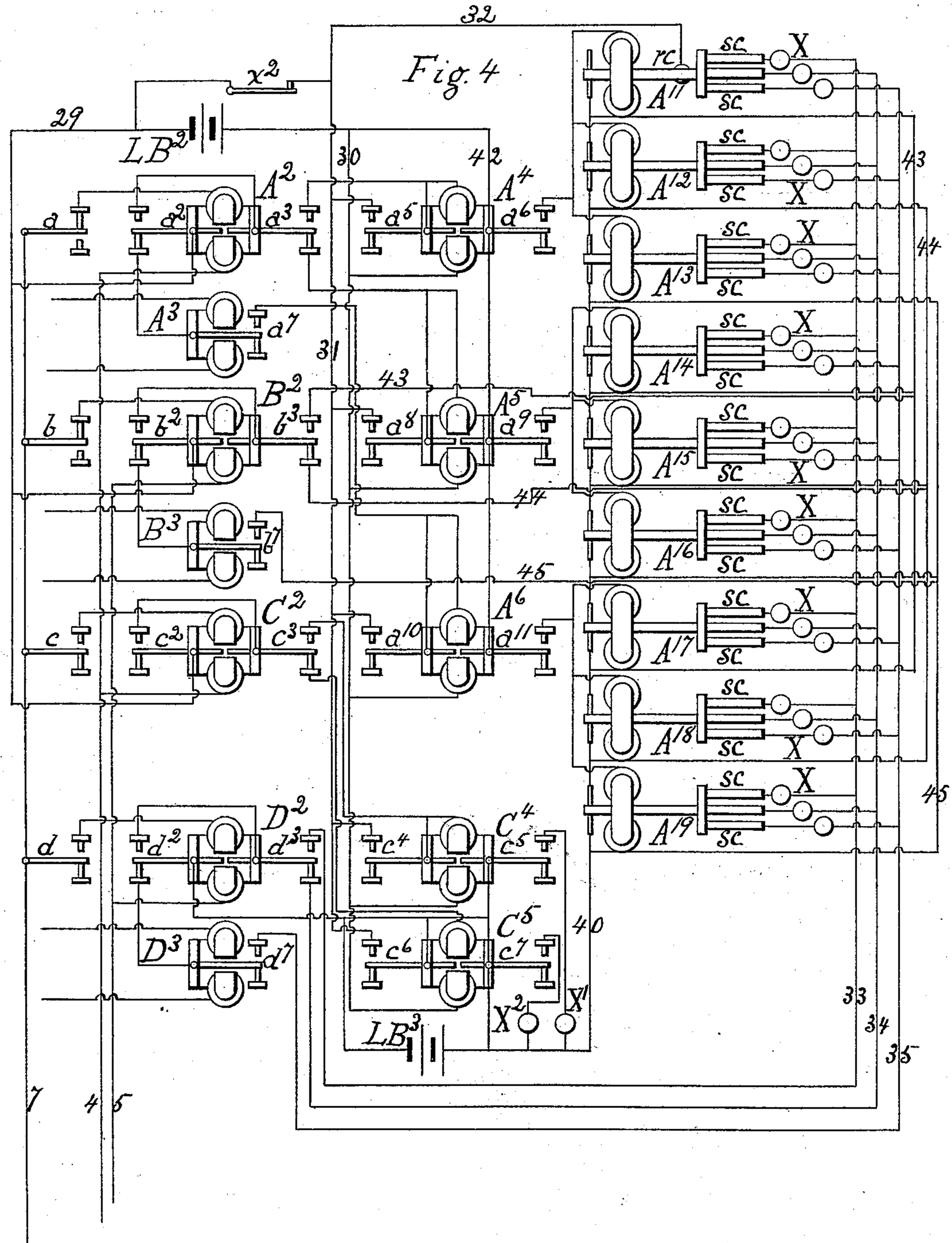
ELECTRIC TELEGRAPH.

No. 551,948. Patented Dec. 24, 1895.

Fig. 4



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(No Model.)

10 Sheets—Sheet 5.

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ELECTRIC TELEGRAPH.

No. 551,948. Patented Dec. 24, 1895.

Fig. 5

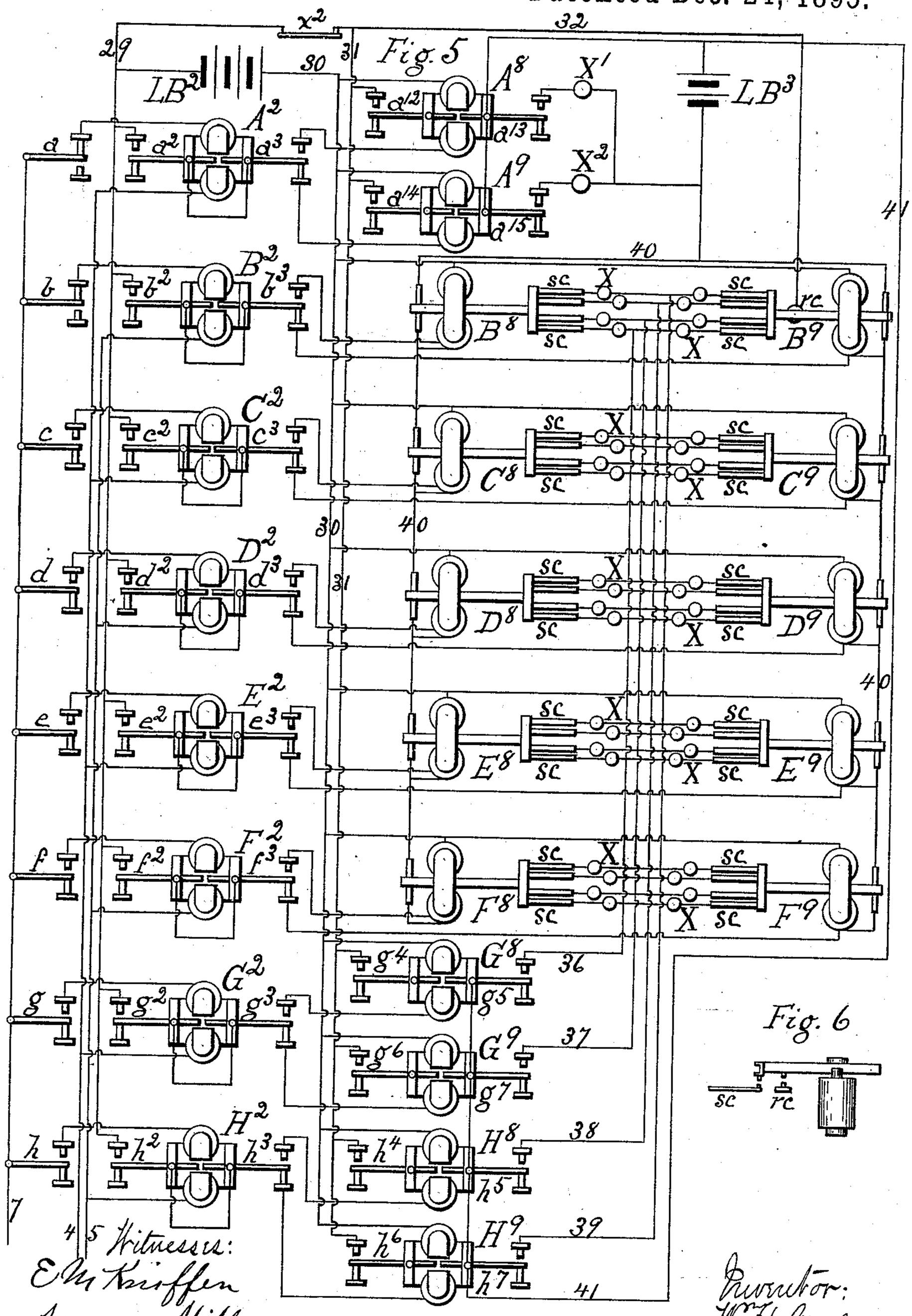

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Fig. 6

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(No Model.) 10 Sheets—Sheet 6.

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No. 551,948. Patented Dec. 24, 1895.

Fig. 7

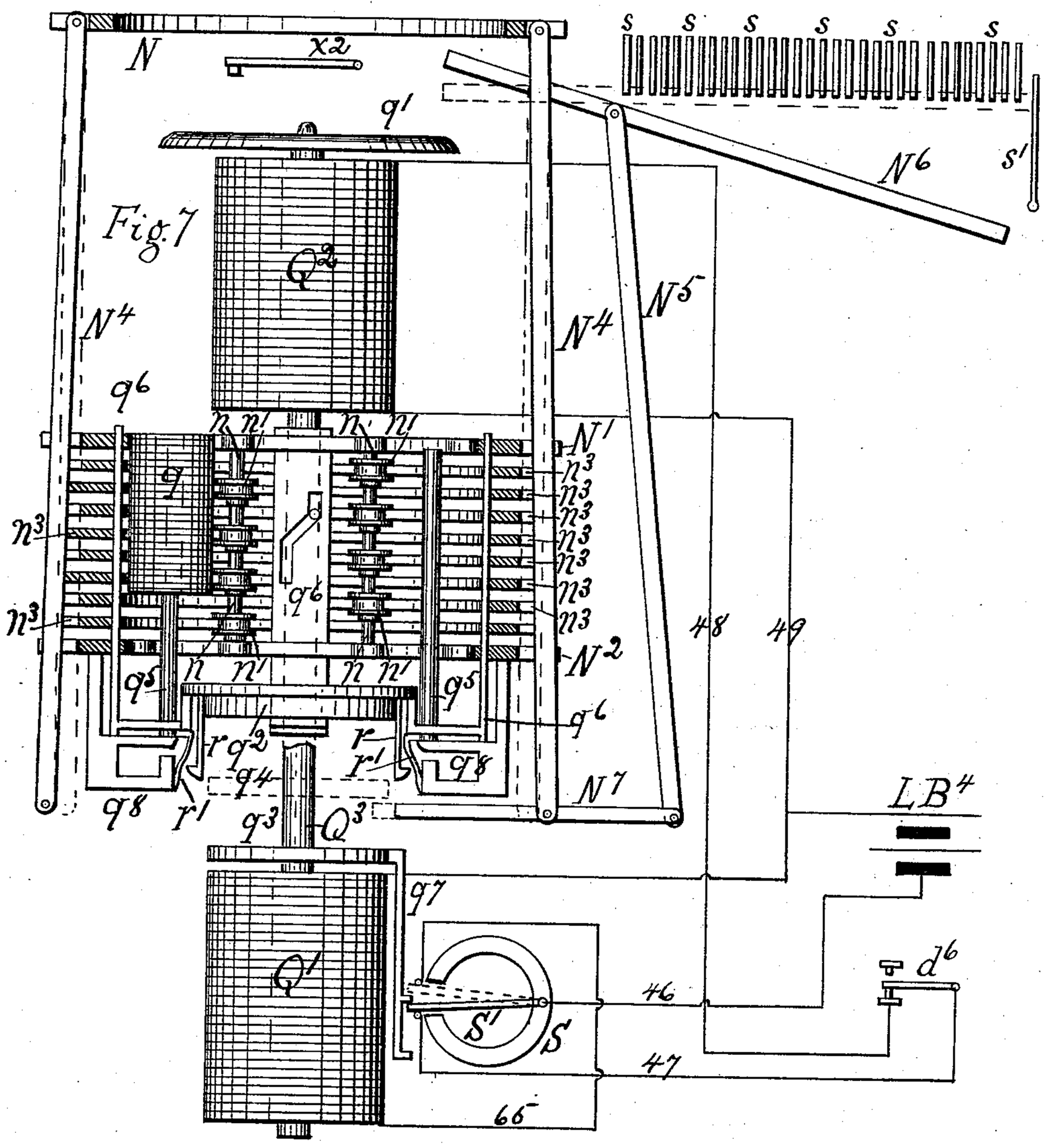
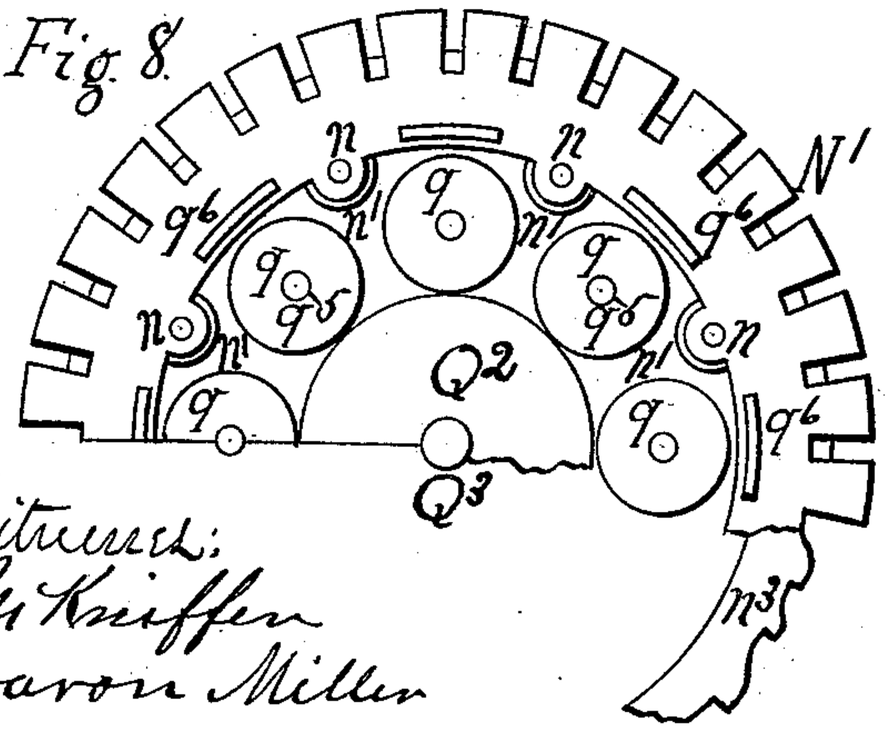


Fig. 8.



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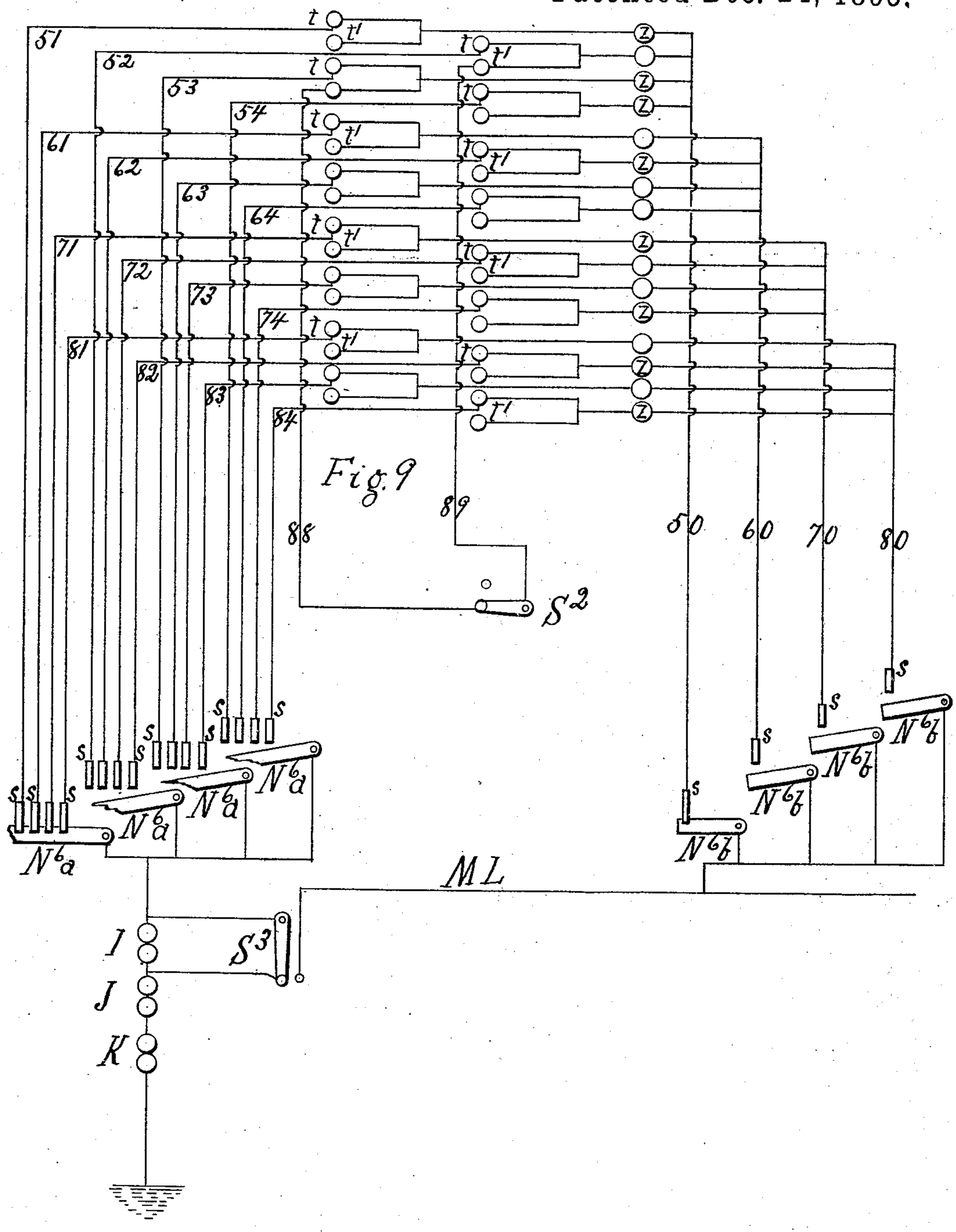

Fig. 9

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ELECTRIC TELEGRAPH.

No. 551,948. Patented Dec. 24, 1895.

Fig. 10

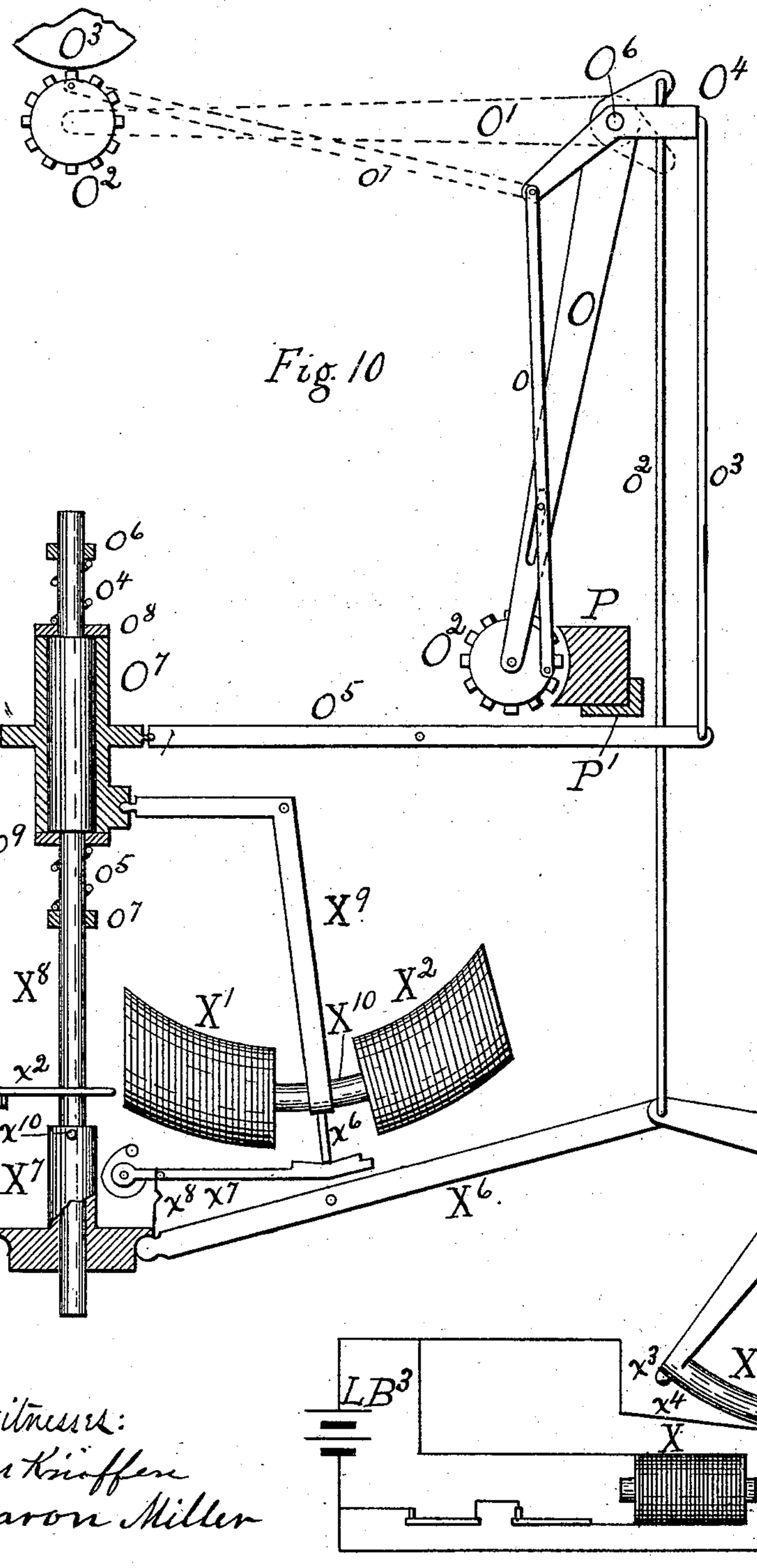


Fig. 12

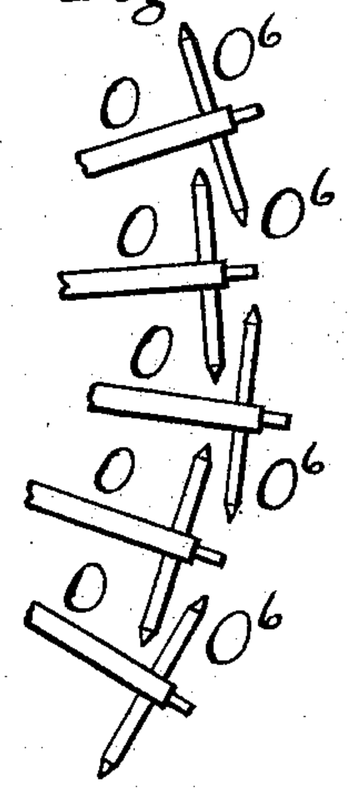
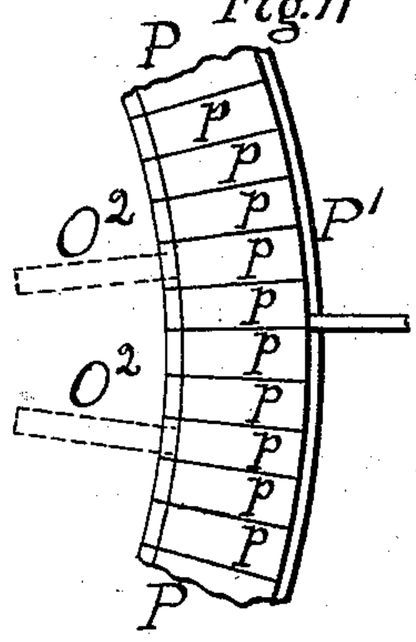


Fig. 11



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ELECTRIC TELEGRAPH.

No. 551,948 Patented Dec. 24, 1895.

Fig. 13

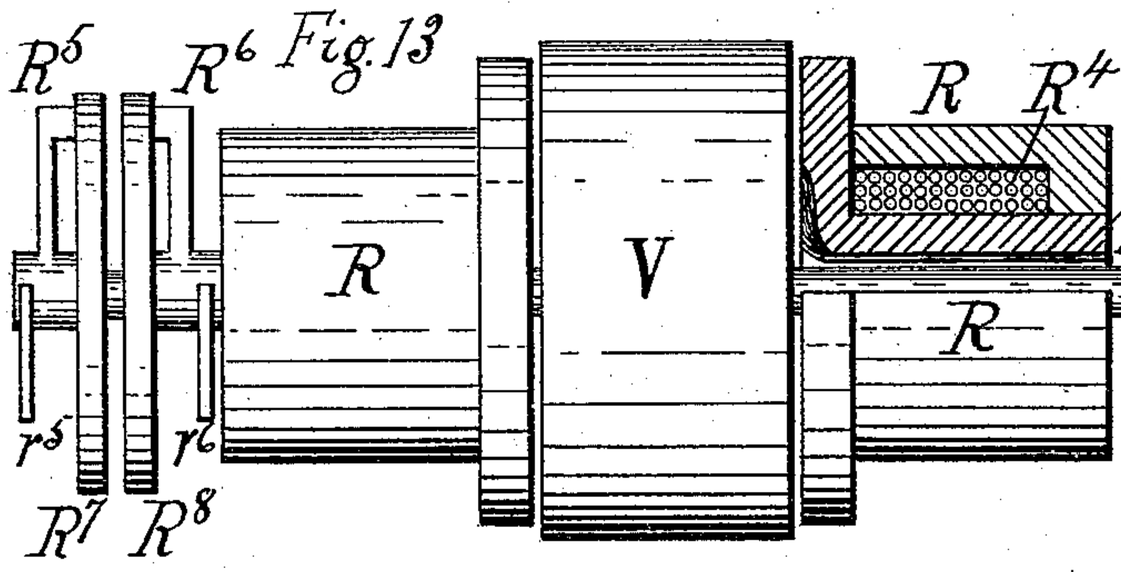


Fig. 14

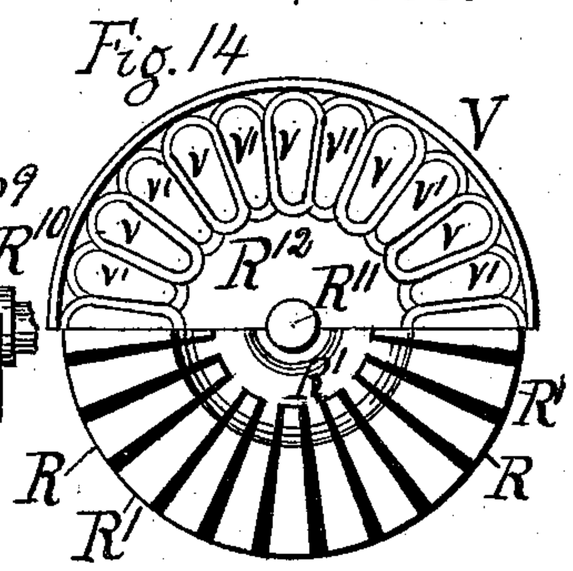


Fig. 15

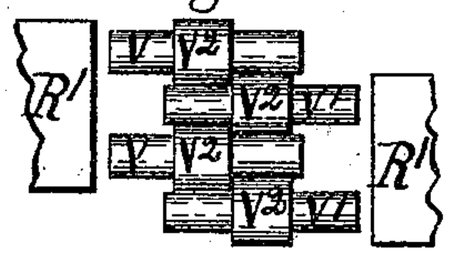


Fig. 17

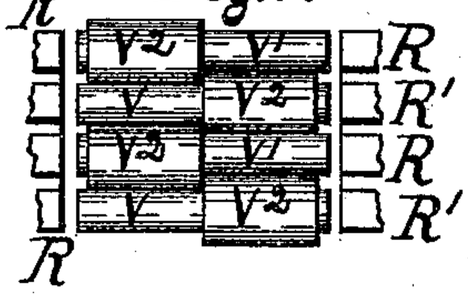
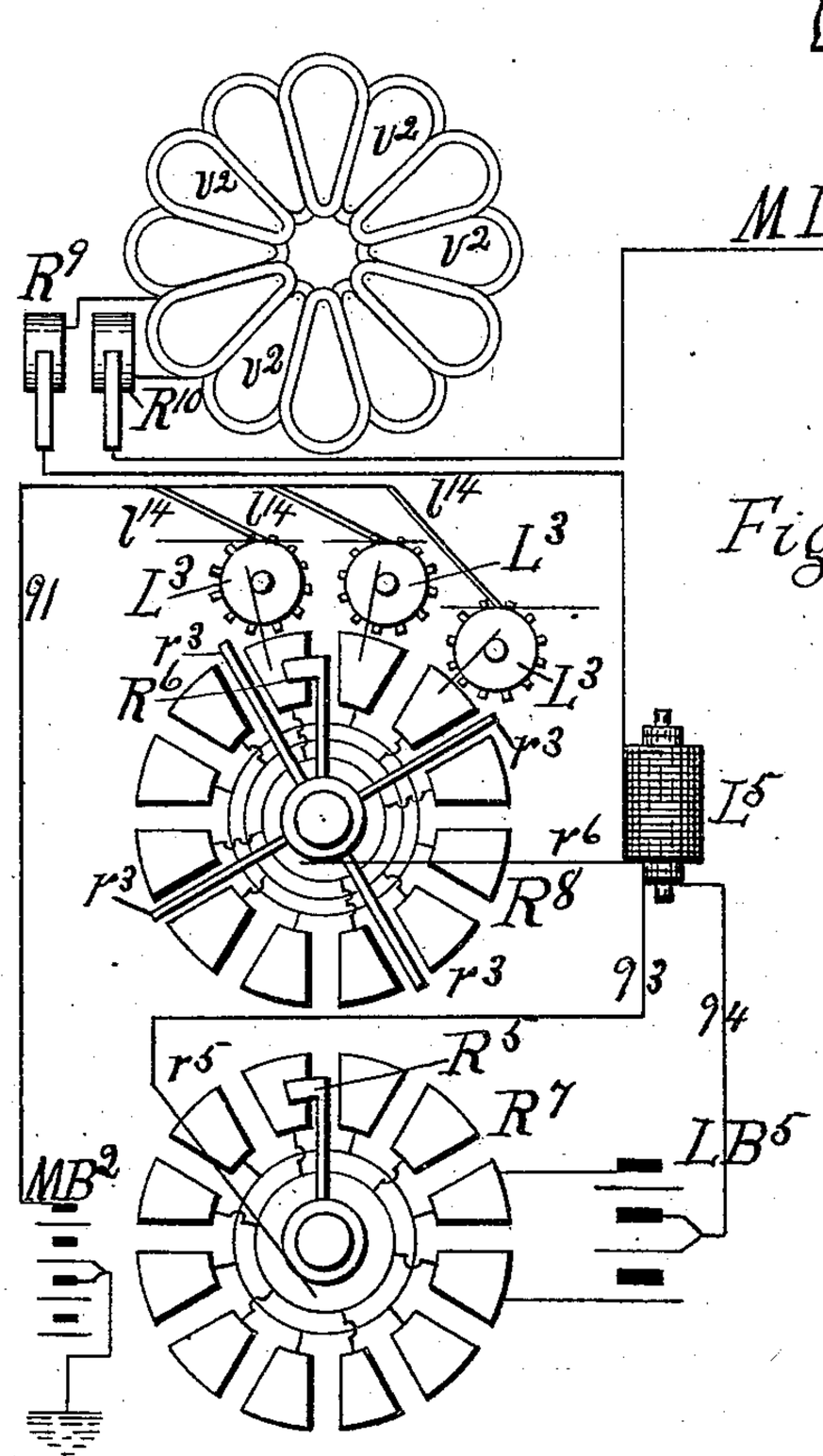
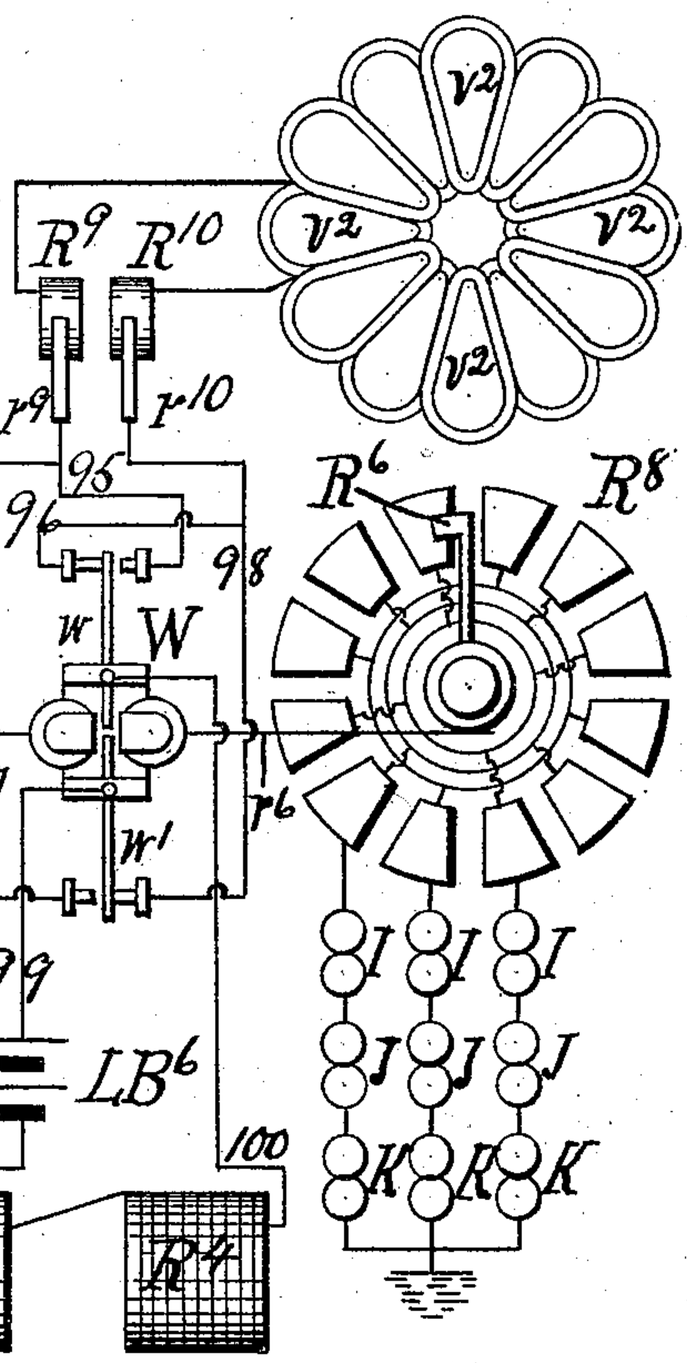


Fig. 16





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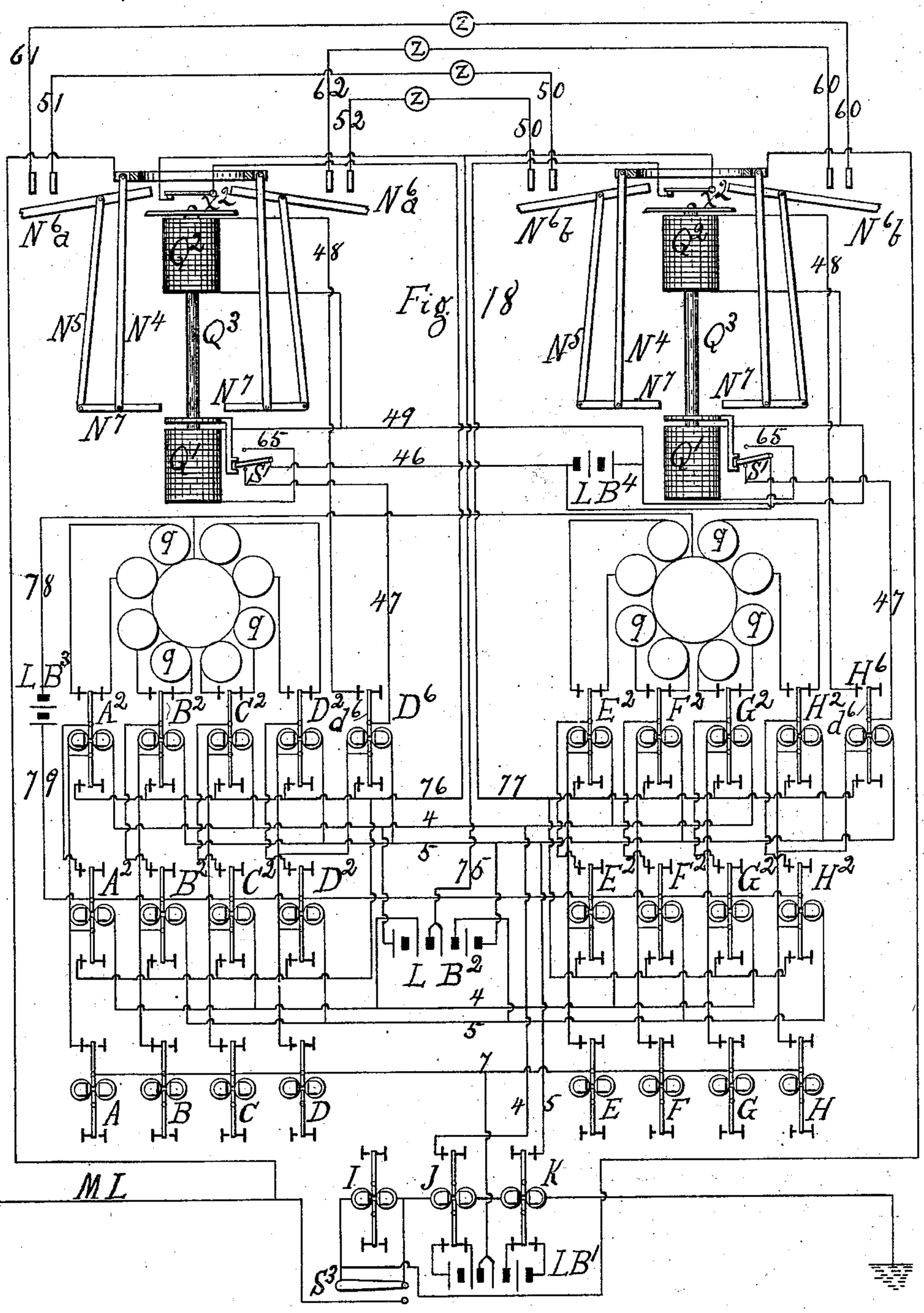
ELECTRIC TELEGRAPH.

No. 551,948. Patented Dec. 24, 1895.



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Inventor:
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UNITED STATES PATENT OFFICE.

WILLIAM H. COOLEY, OF BROCKPORT, NEW YORK.

ELECTRIC TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 551,948, dated December 24, 1895.

Application filed April 18, 1893. Serial No. 470,899. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. COOLEY, a citizen of the United States, residing at Brockport, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Electric Telegraphs, of which the following is a specification.

The object of my invention is to provide a direct type-printing telegraph adapted either to automatic or to key transmission without change and to dispense, except in cases of synchronous multiplexing of the work, with all synchronous or step-by-step movements and sunflower distributers and revolving parts, and also the movement of heavy parts in the receiving-printer, such as the carriage or keyboard or similar heavy parts in type-printing telegraphs when operated by shifting-keys or their equivalents, and that too while still employing the equivalent of shift-keys in a type-writer, so as to reduce to the minimum the number of type-bars and the work of selecting them.

Another object of my invention is the lengthening of the time allowed at the receiving-station for the printing of a character without diminishing the speed of transmission and receiving.

A further object is to provide an automatic switching device for a central station adapted to use in connection with my automatic receiving-current distributer and to be operated from a transmitting-key.

A still further object is to provide an apparatus for synchronously multiplexing the work of my system calling for the construction of a special synchronizing apparatus.

Other objects and features of my invention will be hereinafter explained.

For the sake of perspicuity and brevity I shall show and describe herein only such portions of a telegraphic system embodying my improvements as is necessary to illustrate the same, reference being made to the accompanying drawings, in which—

Figure 1 shows in side view two of my transmitting-keys and also my automatic transmitting apparatus with the circuit connections for the same and also for such keys indicated in diagram. In the figure also are seen in partial vertical section my perforating-punches. Fig. 1^a shows an end view of the roller L^3 of Fig. 1. Fig. 1^b shows in enlarged face view the contact-pieces opposed to my transmitting-keys, and indicates the circuit connections for each of such contact-pieces, while in the extreme right in this figure is seen in detached position the contact-pieces opposed to the seventh and eighth keys with the circuit connections therefor more fully indicated. Fig. 1^c shows in top or plan view my perforating-punches and the rods m and m^9 and their connecting-plates M, while Fig 1^d shows a top view of bed-piece L^2 and the holes therein opposed to the perforating-punches. Figs. 2 and 3 show slightly-different modifications of my receiving-current distributer and connections, largely in diagram, while Figs. 4 and 5 show in similar diagrams similar modifications of my selecting device for directing the current of the local-printing battery to the proper type-bar-actuating devices and to the proper shifting devices and the connections therefor. Fig. 6 shows in side view one of my branch relays used in making such selections. Fig. 7 shows partly in vertical section my automatic switch-lever or bar-controlling device with some parts thereof removed for the sake of perspicuity, while Fig. 8 shows a partial plan view of the same; and Fig. 9 shows in diagram the circuit connections used in and with my switching device, showing sixteen subscribers' circuits in an enlarged view from that seen in Fig. 18. Fig. 10 shows in elevation one of my printing or type bars with its connections and the means for operating the same. Fig. 11 shows in partial top view the inking-pad; and Fig. 12 shows in partial outline plan view the type-bars to my printer, illustrating their arrangement. Figs. 13, 14, 15, 16, and 17 show details in the construction and circuit connections of my synchronizing apparatus for multiplexing my system, as will be explained. Fig. 18 shows partly in plan and side view diagram a central station and the connections therefor when equipped with my switching apparatus.

Similar letters and numerals refer to similar parts throughout the several figures.

Referring to Fig. 1, M′ M^2 are metallic key-bars articulating upon metallic rod m, and having secured upon their free ends spring-catches m^7, arranged to catch and hold, as seen,

the trailer-springs m^5, making contact successively with the contact-pieces m', m^2, m^3 and m^4, thoroughly insulated from each other in the manner indicated by quite thick strips of insulating material. Of course it will be understood that each key-bar with its trailer-spring has opposed thereto a separate and different series of contact-pieces insulated from the series on either side of it, except, first, in cases where two or more adjacent contact-pieces of the same letter make the same connection with battery M B', and, second, in case of that horizontal row of contacts, all of the same letter, used to control the shifting device, and in this case these contacts may all consist of one strip connected to a switch making battery connections, such as and in the manner indicated in side view in the case of any one of contact-pieces m', m^2, m^3 and m^4 in Fig. 1[b], showing the spacer-key by which, by the changes hereinafter described being made in the switches, my automatic switching devices are controlled. Any key on being depressed from the position M' to the position M^2 makes electric connection between rod m and contact-pieces m', m^2, m^3 and m^4 successively, and upon reaching the position M^2 trailer m^5 has when striking fixed rod m^8 been pushed to the right and caused to engage spring-catch m^7, and immediately upon the release of the key it is by means of any suitable spring, as m^{10}, caused to return to the position indicated, M', whereupon, spring-catch m^7 being depressed by fixed rod m^6, it is disengaged from trailer m^5, allowing the same to return to its normal position ready for the next depression of the key and in contact with the thick insulating-strip indicated at the top of the series of contact-pieces.

Referring to Figs. 1 and 1[b], I will now describe the circuit connections made with the contact-pieces of my spacer-key. Dotted portions of lines 12 and 13, as seen in Fig. 1, connect opposite sides of battery M B, respectively, with contact-pieces m' m^3 and m^2 m^4, while the neutral point of this battery M B is connected by wire 11 with one end of the primary of the induction-coil L, having its secondary in the main line and the other end of its primary connected by wire 10 with rod m. Thereby it will be seen that the depression of the spacer-key sends to line M L four alternating induced currents or impulses from the secondary of induction-coil L.

I will now describe the battery connections made with the contact-pieces for one of the other keys. Wires 14 and 15 are connected to contact-pieces m' and m^3 and wires 17 and 18 with contact-pieces m^2 and m^4, respectively. Wires 14 and 15 are connected with battery M B' at different points on one side of the neutral point thereof, while wires 17 and 18 are similarly connected at different points on the other side of this neutral point, from which in turn wire 16 leads to ground. Thus it will be seen the depression of that key opposed to such contact-pieces sends to line alternating impulses varying in strength also from battery M B'. Each key beside the spacer-key has a different arrangement of battery connections for its contact-pieces, such that each key will send one or more battery impulses, positive or negative, or weak or strong, as desired. At each end of the rod m is secured a heavy metallic and L-shaped bar M, connected at their outer ends by the metallic rod m^9, coming just under the key-bars M' M^2, &c., when each of such key-bars is held up and in its normal position by means of springs m^{10}, as shown. Each key-bar as it is depressed carries with it the rod m^9, which is kept in a horizontal position by means of its rigid connection with the heavy bars M, and to this rod m^9 is secured, in any suitable manner, such one of keys M' M^2, &c., as it is desired to use for the spacer-key, and having connections made therefor with its contact-pieces, such as already described. Thus it will be seen that the spacer-key may be depressed alone, sending only induced impulses to line alternating in kind, and that each other key when depressed carries with it the spacer-key, and also sending to line one or more battery impulses synchronizing and harmonizing with such induced impulses.

In Fig. 1[c] there is shown in plan view bars M, rods m and m^9, and also the E-shaped plates or bars l' l^2 l^3 to l^8, carrying my perforating-punches, and also the similar punch-bars z', z^2, z^3 and z^4.

For a clearer explanation of my transmitting-keyboard and the circuit connections therefor reference is made to Fig. 1[b], which shows in the body of the figure twenty-eight vertically-arranged series of contact-pieces m' m^2 m^3 m^4, arranged, as seen, in four horizontal rows. All those from the second to the twenty-sixth, inclusive, in the rows m', m^2, and m^3 are (some one or more of them) connected to battery M B', those in rows m' and m^3 at the left-hand side, which we will call for convenience the "positive" side, and all those in the row m^2 to the negative or right-hand side—that is, all those marked S are arranged to send a strong and all those marked W a weaker current to line from battery M B', while those unmarked and left blank are connected to wire 16 leading to ground. This is more clearly indicated in the case of the seventh and eighth vertical series opposed to the seventh and eighth keys. (Shown with their connections in detached position to the extreme right in this figure.) The lower row of contacts m^4 for keys 2 to 26, inclusive, consists of a single continuous piece, as shown, connected to a switch S^{15}. (Seen in the drawings on its central contact connected through wire 16 to ground.)

The switch S^{15}, which is essentially a representation in diagram of my shift-key, may be moved to its left or right hand contact so connected, as seen, with battery M B' as to send respectively weak or stronger currents or impulses from battery M B' to line and

negative in kind. Thus it will be seen that any battery impulse sent by any key from any contact-piece in the first and third rows m' and m^3 will be a positive impulse and any battery impulse sent by any key from any contact-piece in the second and fourth rows m^2 and m^4 will be a negative impulse.

Very obviously any desired one of the rows of contact-pieces m' m^2 m^3 m^4 for keys 2 to 26, inclusive, can be made continuous and connected with switch S^{15}; but the lower one is selected for convenience in the drawings.

As already before said, all of the keys carry with them a spacer-key, and for convenience I prefer to oppose to such spacer-key the twenty-eighth vertical series of contact-pieces, the first, second, third, and fourth of which are respectively connected with switches S^{11}, S^{12}, S^{13}, and S^{14}. (All seen in the drawings on their central contacts.) All of these central contacts are double, each consisting of two semicircular contacts insulated from each other and having their right-hand sections all connected, as indicated, through wire 16 to ground, while the left-hand sections of these central contacts for switches S^{11} and S^{13} are connected through wire 12 to the left-hand side of battery M B and the left-hand sections of the central contacts for switches S^{12} and S^{14} are connected through wire 13 to the right-hand side of battery M B, from the neutral point of which wire 11 makes connection, as already described. Hence the depression of the spacer-key opposed to the twenty-eighth vertical series of contact-pieces sends to line four alternating induced impulses or currents in the manner already described, and such spacer-key by means of its connection with rod m^9 is always depressed by the operation of any other key, whereby it will be seen that each key sends to line four alternating induced impulses, and harmonizing and synchronizing therewith one or more battery impulses, strong or weak, as desired, and according to the connections of the contact-pieces opposed to each of such keys.

Switches S^{11} S^{12} S^{13} S^{14} may be dispensed with and the spacer-key contacts connected directly with and only with the battery M B, as indicated in Fig. 1. In this case, then, I make use of an additional series of spacer-key contacts, being the first series shown to the extreme left in Fig. 1^b, each connected through wire 16 to ground, as seen, and opposed to this series of contact-pieces, in this case, I locate a key similar to any of the others and disconnected from rod m^9. This key, it will be seen, sends no battery-currents to line, but only induced currents through its operation of the already-described spacer-key. This key, it will be further seen, forms at its successive contacts a ground connection for the induced impulses sent from the spacer-key, traversing rod m and this key and its contacts and their connections in reaching the ground at the sending-station. A similar ground connection is similarly formed by the unmarked contact-pieces of the other twenty-six keys connected through wire 16 to ground, while when a battery-impulse is sent to line the ground connection is made through some part of battery M B'. In place of this arrangement a permanent ground connection may be supplied through a rheostat T, as seen in Fig. 1, properly adjusted and used in the manner already well known in the art and located as seen in the drawings and connected with wire 19 and through wire 16 to ground. Articulating also upon this rod m' are seen eight **E**-shaped bars loosely nested within each other so as to be capable of independent motion, and with their central members or portions opposed to the key-bars M' M^2, &c., so as to be struck by such key-bars when near the bottom of their course. The central members or portions of these **E**-shaped bars l' l^2 to l^8 are shown in vertical section and have projecting downward from each a perforating-punch, as seen, arranged to perforate the ribbon L' by passing therethrough and into holes therefor in bed-piece L^2 opposed to such perforating-punches, and over which ribbon L' is caused, by means of any suitable mechanism not shown, to pass, advancing at each perforation of a character a longitudinal space or distance covered by the perforations representing a character. Four of these perforating-punches extend straight downward, while the other four are curved so as to come in the same longitudinal lines in ribbon L' with those extending straight downward. Each of these bars l' l^2 l^3 to l^8 is returned to and held in its normal position by means of a spring m^{10}. Each of the key-bars M' M^2, &c., is differently notched out on the under side, as indicated, so as to operate no one of the punches or any one or any combination of two, three or four at a time, except that no two adjacent ones in the same line transversely of ribbon L' shall be operated from the same keys. These perforations thus produced in ribbon L' are, as seen, located alternately upon one side and the other of the longitudinal row of centrally-arranged smaller perforations in ribbon L' arranged to engage the carrying-pins l on metallic roller L^3 (seen also in end view in Fig. 1^a) as the same is caused to revolve in any suitable manner, (not shown,) thus advancing ribbon L'. This roller L^3 has projecting from either end thereof contact-pins l^9, alternating in position and arranged, as seen, to engage alternating contact-springs l^{10} and l^{15} connected respectively by means of wires 12 and 13 with battery M B on opposite sides thereof. As noticed these contact-springs are arranged to make contact with alternating contact-pins l^9 synchronously with the contact of needles l^{11}, l^{12}, l^{13}, and l^{14} through perforations therefor in ribbon L' and roller L^3—that is, when such perforations occur. Spring l^{16} bearing on shaft L^4 of roller L^3 is connected by wires 19 and 10 with the primary of coil L, and also through the secondary thereof with main line

M L. Contact-needles l^{11}, l^{12}, l^{13}, and l^{14} make respectively by means of wires 14, 15, 17, and 18 such connection with battery M B′ as already described in regard to contact-pieces m', m^2, m^3, and m^4, and thereby producing, as will be readily understood, the same transmitting-impulses from battery M B′ when these contact-needles come in contact with roller L^3 through perforations in ribbon L′. Each transmitted character to consist, of course, of from one to four of the larger perforations in ribbon L′, all corresponding in position longitudinally on ribbon L′, as seen, with the smaller perforations in the central longitudinal row, while for operating a spacer-key none of these larger perforations are used.

A series of four perforating punch-bars z', z^2, z^3, and z^4, as seen, is located within the series of plates l' l^2 l^3, &c., except that their end sections form, so far as they go, four of the separating-washers between the bars l' l^2 l^3, &c., where they articulate on rod m. Each of these bars z', z^2, z^3, and z^4 is also E-shaped and has extending outward to the left from a point near the center of the central member of each a perforating-punch extending downward also and arranged to enter holes therefor in the extreme right-hand edge of bed-piece L^2. (Seen also in top view in Fig. 1^d.) The punch formed on bar z^2 passes through a vertical slot therefor in bar z', and in the same way the punches formed on bars z^3 and z^4 pass through vertical slots therefor in bars z', z^2, and z^3 in a manner so as to allow any one of such punches to be operated singly. The transmitting-keys M′ M^2, &c., are so notched out on their under sides with reference to those punch-bars that when no perforation is formed opposite one of the central smaller perforations in ribbon L′ then one of these punches z', z^2, z^3, or z^4 shall be brought into operation, making a perforation transversely opposite to such central smaller perforation and at the extreme right-hand edge of the ribbon L′; and opposed to such perforations so formed there is located the contact-needle l^{17} connected through wire 16 to ground and performing the same office in the automatic transmission, as will be readily understood, that the connections made through wire 16 between the unmarked contact-pieces m', m^2, m^3, and m^4 and the ground, as seen and indicated in Fig. 1^b. This arrangement, however, may be dispensed with and the rheostat T or its equivalent used in place thereof in the manner already described. Springs m^{10} are used to return to and hold in their normal positions the punch-bars z', z^2, z^3, and z^4. Thus it will be seen that by automatic transmission by perforated ribbon L′ there are sent to line four alternating induced impulses and one or more battery impulses harmonizing and synchronizing therewith, these battery impulses being weak or strong, as already indicated and described. These induced impulses I use to operate and make certain that at the time of each battery impulse, whether sent or not, there shall be sent to line an impulse which shall operate only a relay controlling my automatic current-distributer and also, when desired, another portion of my receiving apparatus, while the battery impulses of different strength are caused to operate other parts of my receiving apparatus, as will be explained—that is, I prefer to energize the actuating-coils of my receiving current-distributer from an electric circuit controlled by a main-line relay actuated by high-tension impulses, while at the same time, when so desired, such high-tension impulses may be used to actuate other parts of my receiving apparatus, as shown, although I do not limit myself to the use of such high-tension impulses for actuating the relay controlling my distributer.

Referring to Figs. 2 and 3, which show my automatic current-distributer, M L represents the main line at the receiving-station going to ground, as indicated, after passing through the coils of relays I J K. These relays, like several others which I prefer to make use of in my receiving apparatus, are polarized relays, as indicated, having each two armatures each trunnioned in a separate permanent magnet. The armatures of each relay, as well as all parts with which they come in electric contact, are insulated from each other in any suitable manner, (not shown;) but in other respects these relays are of substantially the usual construction. It will of course be understood that either armature of each relay can be adjusted to respond to impulses only positive or negative in kind, and that, too, independently of the adjustment of the other armature of the same relay. Armatures i and i' of relay I have each a bias tending to return them normally to the position shown in the drawings.

In my automatic current-distributer I make use of similar relays A B C to H, having armatures a b c to h and a' b' c' to h', respectively, and having each a neutral adjustment and working contacts on the left-hand sides thereof only, as shown. The actuating-coils of these relays are connected together in the following manner, viz: in circuit 21 and in series therein the right-hand coil of relay A, left-hand coil of relay C, secondary of induction-coil A′, and any suitable receiving-coil A^3; in circuit 22 in the same way right-hand coil of relay B, left-hand coil of relay D, secondary of coil B′, and any receiving-coil B^3; in circuit 23 right-hand coil of relay C, left-hand coil of relay A, secondary of coil C′, and any receiving-coil C^3, and in circuit 24 right-hand coil of relay D, left-hand coil of relay B, secondary of coil D′, and any receiving-coil D^3. By a further reference to Fig. 3 and the plan of lettering adopted therein it will be seen that this system of connections is used with the other relays E, F, G and H.

Referring to Fig. 2 and starting with the several parts in the positions indicated in the drawings, the first main-line impulse, say a

positive one, throws armature *i* to the left-hand contact, causing current of battery L B, having its terminals, as seen, connected with the trunnions of armatures *i* and *i'*, to pass through wire 8, primary of induction-coil A', armature *a'*, wire 1 connected with the trunnion thereof, and armature *i'* back to battery L B, thus inducing in the secondary of coil A' an impulse tending to hold more strongly in their present positions armatures *a a' c c'*. The immediately succeeding negative impulse on the main line throws armature *i* back to its right-hand contact and also armature *i'* over to its right-hand contact, shutting off from the primary of coil A' the current of battery L B, but causing it in a similar manner to traverse, by means of wires 9 and 2, the primary coil B' through armature *b'* and wire 2 connected with the trunnion thereof. The inverse impulse induced in the secondary of coil A' by the shutting off from its primary of the current of battery L B causes armatures *a* and *a'* to move over to their back contacts on the right and armatures *c* and *c'* over to the left on their working contacts, while the impulse induced at the same time in the secondary of coil B tends to hold more strongly armatures *b* and *b'* on their working contacts and armatures *d* and *d'* on their back contacts. The third, a positive impulse on the main line, throws armatures *i* and *i'* over onto their left-hand contacts, causing current of battery L B to traverse the primary of coil C' and shutting it off from the primary of coil B', induces in the secondary thereof impulses causing armatures *b* and *b'* to move to their right on their back contacts, armatures *d* and *d'* to strike their working contacts on the left, and also tending to hold more strongly against their working contacts armatures *c* and *c'*, and also to hold more strongly against their back contacts armatures *a* and *a'*. The fourth, a negative impulse on the main line, throws armatures *i* and *i'* against their right-hand contacts, shutting off the current of battery L B from the primary of coil C' and causing it to traverse the primary of coil D', inducing in the secondaries thereof impulses causing armatures *a* and *a'* and *c* and *c'* to return to the positions indicated in the drawings, and tending to hold more firmly against their left-hand or working contacts armatures *d* and *d'*, and also more firmly against their back contacts armatures *b* and *b'*. Upon the cessation of this fourth impulse, whether immediately succeeded by another (positive) one or not, armature *i* returns to its normal position indicated in the drawings, shutting off current of battery L B from the primary of coil D', and thus inducing in the secondary thereof an impulse causing armatures *d* and *d'* and *b* and *b'* to return to the positions shown in the drawings, ready for the next series of four impulses used in transmitting the next character.

By referring to Fig. 3 and the plan of lettering adopted therein, provision is made, it will be seen, in the same way for eight alternating impulses in each series, and that in the same way also provision can be made for any desired number.

Referring to Fig. 2, armatures *j* and *j'* have their working contacts to the left and armatures *k* and *k'* have their working contacts to the right, while the split battery L B' is connected on one side, as seen, with the trunnions of armatures *j* and *k'* and on the other side with the trunnions of armatures *k* and *j'*. Armatures *j* and *j'* are arranged to respond only to positive impulses and armatures *k* and *k'* only to negative impulses. Armatures *j* and *k* are adjusted to respond to feeble battery impulses on the main line and armatures *j'* and *k'* to respond only to the stronger battery impulses. Neither of the armatures *j*, *j'*, *k* or *k'* should respond to the induced impulses sent to line in the manner described to operate relay I, whereby connections being made such as indicated by lines 3, 4, 5, 6 and 7 it will be seen that during the time of each one of the four transmitted impulses—viz., first, second, third and fourth—either one singly or both together or neither one respectively of the pairs of coils A^2, B^2, C^2, and D^2 may be placed in circuit with the battery L B'.

Referring to Fig. 3, in this case armatures *j* and *k* are arranged to respond to the feeble and armatures *j'* and *k'* only to the stronger battery impulses on the main line. Armatures *j'* and *k'* have working contacts on both sides of each, each armature resting normally against a contact connected with the split battery L B' at points between the center and the extreme positive and negative sides thereof, to which respectively the left and right hand contacts of armatures *j'* and *k'* are connected, as seen, whereby it will be readily understood that connections being made by means of wires 4, 5, and 7 during the time of the eight transmitted impulses in each series, in this case taken in their regular order, the coils A^2, B^2, C^2 to H^2 may be caused to be traversed or not, as desired, by either feeble or strong currents from battery L B', each one of such coils receiving, if at all, its impulse only when the corresponding main-line impulse is sent, and that no matter how often repeated the series of impulses may be, for which provision is made, corresponding impulses in each series will cause only corresponding coils to be energized, and such coils to be energized only when desired. By making connections such as indicated by dotted lines 10 and 11 and by omitting relays J and K and the portion of the main line M L contained between points *x* and *x'*, then it will be seen that the main-line impulses will be caused to traverse directly coils A^2, B^2, C^2 to H^2 instead of causing such coils to be traversed by relayed impulses or currents. It will also be readily seen that by omitting relays B, D, F, and H and their corresponding connections and substituting a neutral relay in place of relay I

and also a neutral relay in place of relay J, if used at all, and omitting also relay K, then every first, second, third and fourth main-line impulse, either directly or a local impulse relayed therefrom, will traverse respectively coils A^2 C^2 E^2 G^2 irrespective of the direction of such main-line impulses whether positive or negative.

Referring to Fig. 5, there are seen to the left armatures a b c to h, wires 4, 5 and 7, and also relays A^2 B^2 C^2 to H^2, any one, two or more or no one of which may be caused to be energized by feeble or strong battery impulses either from the main line or relayed and from a local battery in the manner shown in Fig. 3 and already described. These relays A^2 B^2 C^2 to H^2 are similar to relays J K of Fig. 3 and have their armatures similarly adjusted and connected by a wire connecting their trunnions, as indicated; but instead of using this wire the insulation between the armatures can be dispensed with. In practice this is done; but the wire is shown in the drawings for the sake of clearness. Armatures a^2 b^2 c^2 to h^2 have their working contacts shown above them in the drawings and connected to a wire 29 from battery L B^2. Armatures a^3 b^3 c^3 to h^3 have both their contacts working contacts, their upper contacts connected in each case with the coils of a relay lettered respectively A^8 B^8 C^8 to H^8, and their lower contacts to the coils of a relay lettered respectively A^9 B^9 C^9 to H^9, while the other ends of the coils of these relays A^8 A^9 B^8 B^9 C^8 C^9 to H^8 H^9 are connected, as seen, with the wire 30, leading to the other side of battery L B^2, whereby it will be seen that relay A^8 will be energized from battery L B^2 when both armatures a^2 and a^3 of relay A^2 are moved against their upper contact by a strong battery impulse actuating both of such armatures, and relay A^9 will be energized only when armature a^2 alone is moved against its upper contact by a weaker battery impulse insufficient to operate armature a^3, and that when neither of these armatures a^2 or a^3 is acted upon then neither of the relays A^8 or A^9 will be energized. In the same way either or neither of the relays B^8 B^9 C^8 C^9 to H^8 H^9 may be energized at the time of the second, third, fourth, fifth, sixth, seventh or eighth impulse, respectively. Wires 31 and 32 are connected, as seen, through a spring contact or switch x^2 with the left-hand side of battery L B^2. With wire 31 there is connected, as seen, the working contacts of armatures a^{12} and a^{14} respectively of relays A^8 and A^9 and also the working contacts of armatures g^4, g^6, h^4 and h^6 respectively of relays G^8, G^9, H^8 and H^9. These relays A^8, A^9, G^8, G^9, H^8 and H^9 are similar to those already described, but have their armatures adjusted to respond synchronously to currents of the same strength and direction. One end of the coils of relay A^8 is connected with the trunnion of armature a^{12} while one end of the coils of relay A^9 is connected with the trunnion of armature a^{14}, while the other ends of the coils of each of these relays is connected with wire 30, as already described, whereby it will be seen that relays A^8 and A^9 when once energized are permanently retained in the circuit of battery L B^2 by means of their retaining-armatures respectively a^{12} and a^{14} and their connections, already described, and in the same way, also, by similar connections, as seen, relays G^8, G^9, H^8 and H^9 when once energized may be retained in the circuit of battery L B^2.

Relays B^8 B^9 C^8 C^9 to F^8 and F^9 have one end of their coils connected, as seen, with a wire 40 connecting all the trunnions of such relays, while the wire 32 is connected with a retaining-contact rc to each of such relays, (but shown in the drawings only in connection with relay B^9 and omitted from the others to avoid confusion.) Thus it will be seen that when any one of the relays B^8 B^9 C^8 C^9 to F^8 and F^9 is energized it also is retained in its energizing-circuit of battery L B^2 by means of its retaining-contact rc and the connections described.

Fig. 6 shows in side view the essential features of one of the last-mentioned relays. They are of substantially the usual construction, as seen, except that a short cross-piece on the end of the armature-levers carries four contacts instead of one, each opposed to a spring-contact sc, so that all may be certain of being struck at each throw of the armature, the retaining-contact rc serving as a stop to limit the motion of the armature against the spring-contacts sc, while any suitable spring and stop (not shown) may be used to produce and limit this motion in the opposite direction. Suitable stops and adjusting devices (not shown) may be used also with spring-contacts sc. From each of these spring-contacts sc connection is made, as seen, through coils X with one of the wires 36, 37, 38 or 39. The upper spring-contacts of each of these relays are connected through their coils with wire 39, and the next spring-contacts below through their coils with wire 38, and the next one below that through their coils with wire 37, and the lower ones through their coils with wire 36. Wires 36, 37, 38 and 39 are connected respectively with the working contacts of armatures g^5, g^7, h^5 and h^7, while a wire 41 makes a common connection, as seen, with the trunnions of these armatures and is also connected with battery L B^3 on one side and from the other side of which connection is made with wire 40, whereby it will be seen that any one of the coils X (forty in number) may be placed in circuit of battery L B^3 by the energizing of that one of the branch relays B^8 B^9 C^8 C^9 to F^8 F^9 with one of whose spring-contacts sc the desired coil X has one of its terminals connected, and by the energizing of that one of relays G^8, G^9, H^8 and H^9 with the wire leading from the working contact of the right-hand armature of which that same coil X is connected at its other end. Coils X′ and X^2 have each one of their ends connected

with one side of battery L B^3 and have also their other ends connected with the working contacts respectively of armatures a^{13} and a^{15}, a common connection with the trunnions of which is made with the other side of battery L B^3, as seen, whereby these coils X′ and X^2 are caused to be energized by the current of battery L B^3 by the operation respectively of relays A^8 and A^9. Thus it will be seen that for each series of eight alternating impulses sent to line either one or neither of the coils X′ X^2 may be energized and any desired one of coils X, and that such coils, so energized, may be retained in their energizing-circuit until the same has been broken by the opening of spring-switch x^2 in the manner hereinafter explained.

Referring to Fig. 4, in that phase of my receiving apparatus therein shown only four alternating impulses are required on the main line to cause to be energized either one or neither of the coils X′ X^2 and any desired one of twenty-seven coils X. In this case I make use of connections as follows, viz: Wire 29 is connected with the trunnion of armature a^2, having working contacts on both sides thereof, its upper contact connected with the trunnion of armature a^3 and its lower contact connected with the trunnion of armature a^7, of the single-armatured polar-relay A^3. Similar connections, as seen, are made in the case of relays B^2 and B^3. Relay A^4 has one end of its coils connected with the upper working contact of armature a^3, while its lower working contact is connected with one end of the coils of relay A^5 and the working contact of armature a^7 is connected with one end of the relay A^6. The other ends of the coils of these relays A^4, A^5 and A^6 are connected with wire 30. Wire 42 makes a common connection between battery L B^2 and the trunnions of armature a^6, a^9 and a^{11}. The working contact of armature a^6 is connected with one end of the coils of each of relays A^{11}, A^{12} and A^{13}, the working contact of armature a^9 is connected with one end of the coils of each of relays A^{14}, A^{15} and A^{16}, while the working contact of armature a^{11} is connected with one end of the coils of each of relays A^{17}, A^{18} and A^{19}. The other ends of the coils of all these relays are connected with a wire 40, making a common connection with the trunnions of all of these relays and leading to battery L B^3. The upper contact of armature b^3 is connected by wire 43 with the coils of relays A^{11}, A^{14} and A^{17}, the lower contact of armature b^3 by means of wire 44 with the coils of relays A^{12}, A^{15} and A^{18}, while the working contact of armature b^7 is connected by wire 45 with the coils of relays A^{13}, A^{16} and A^{19}.

When armature a^2 is in the position shown in the drawings, the current of battery L B^2 is caused to pass through armature a^7 to relay A^6. This occurs when the first impulse is an induced impulse only, causing only armature a^7 to respond in the manner already described by the energizing of coils A^3 in connection with Fig. 2. When armature a^2 is moved to its upper contact by a weak battery impulse, not affecting armature a^3, the current of battery L B^2 passes through armature a^3 to coils of relay A^5. When armatures a^2 and a^3 are both moved by a stronger battery impulse on the main line to their upper contacts, then the current of battery L B^2 passes to coils of relay A^4. In the same way the current of battery L B^2 is, by means of relays B^2 and B^3, directed through wires 43, 44 and 45 to the coils of such one of relays A^{11}, A^{12} and A^{13} as have been in the manner already described, by means of relays A^4, A^5 and A^6, connected to the other side of battery L B^2, whereby it will be seen that any one of such relays A^{11}, A^{12} to A^{19} may be energized during the time of the first two main-line impulses. Armature c^2 has its working contact connected with the trunnion of armature c^3, whose upper and lower working contacts respectively are connected with the coils of relays C^4 and C^6, whereby such relays may be energized in the manner explained regarding relays A^4 and A^5. By means of connections being made with wire 31 in this figure, substantially the same as those already described and shown in Fig. 3, relays A^4, A^5, A^6, C^4 and C^5 are retained in the circuit of battery L B^2. By means of wires 32, 40 and 42 and retaining-contacts *rc* (one only of which is seen in the drawings) relays A^{11} A^{12} to A^{19} are also retained or may be retained, when once energized, in the circuit of battery L B^2. Wire 41 connects battery L B^3 with trunnion of armature d^2, whose lower working contact is connected with the trunnion of armature d^7 while its upper contact is connected with the trunnion of armature d^3. Wire 33 is connected with the upper and wire 34 with the lower contact of armature d^3, while wire 35 is connected with the working contact of armature d^7. Wires 33, 34 and 35 are connected respectively with such ones of coils X as are connected to the upper, middle and lower spring-contacts *sc* of relays A^{11} A^{12} to A^{19}, whereby it will be seen that any desired one of coils X may be caused to be traversed by the current of battery L B^3, while coils X′ and X^2 are energized from this same battery in substantially the same manner as already described in regard to the same coils in Fig. 5. Relays A^3, B^3 and D^3 are energized in the manner already described in regard to coils of the same letter in connection with Fig. 2. Thus it will be seen that, by means of four alternating impulses on the main line, of the nature and character already described, there may be selected any one of the twenty-seven coils X and either one or neither of coils X′ X^2.

What has thus far been shown and described applies to stations in permanent telegraphic connection; but when the receiving-station is a central station having a number of subscribers' circuits connected therewith it is necessary to secure connection with the circuit of the subscriber it is desired to communicate with. For this purpose a switching

device is necessary which shall be adapted to use in connection with my receiving-current distributer, and also to other features of my invention. Such a switching device as shall be actuated from one or more of the keys of my transmitting-keyboard is desirable and forms an essential element of my present invention. Such a switching device is shown in Figs. 7 and 8, to which reference is now made. At any central station when it is desirable to use my switching device it is preferable that that modification of my current-distributer shown in Fig. 3 and adapted to eight alternating impulses be used. The first four impulses I use to control one switching device and the second four to control another substantially the duplicate of the first. In that modification of my switching apparatus herein shown I make use of eight selecting disks or washers each controlled by a separate cam-plate; each of these cam-plates, eight in number, actuated from or by a spring-catch on a moving body; each of these spring-catches, also eight in number, normally prevented from engaging such cam-plates by means of much weaker springs, also eight in number, and normally supported or backed by any suitable electrically-controlled device, such as a rod forming the core of a solenoid, and of these solenoids and cores also there are eight. In Fig. 7 for the sake of perspicuity I have shown only one of these solenoids q and its core q^5 and also another core-rod q^5 without its inclosing solenoid, and the two weaker springs r' backed by these rods q^5 and only two of the stronger spring-catches r opposed to such springs r' and the two cam-plates q^6 engaged by such catches r and also a third cam-plate q^6 is seen in face view in the center of the figure. For the sake of perspicuity also, only two of the eight rods n are shown with the supporting-rollers n' thereon. All of these parts omitted from the drawings are exact duplicates of the parts fully shown and hereinafter described. Referring to the drawings, N is a metallic ring pivotally secured in the notches at regular intervals in which are the pendulous bars N^4, falling in the notches therefor in the circular brass plates N′ and N^2, exactly similar and held apart at a uniform distance by means of the rods n, secured in holes therefor in the inner projections formed on plates N′ N^2. Of these rods n there are eight, each one having loosely revolving thereon four grooved rollers n' held in positions indicated in the drawings by means of collars on rods n. Supported by these rollers n' and working in the grooves therein are seen the peripherally-notched washers n^3. There being eight of these rods n and eight of these washers n^3 and four of the rollers n' on each rod n, each washer n^3 is revolubly supported at four equidistant points by four rollers n'.

A series of eight cam-plates q^6, each sliding vertically in holes therefor in plates N′ and N^2 near their inner edges, is seen, each cam-plate having a differently-positioned cam-opening, so that each shall engage a small pin on the inner edge of a different one of washers n^3, passing through the cam-openings therefor, whereby each of these cam-plates q^6 as it is raised causes a different one of washers n^3 to be turned a fixed distance to the right. These plates q^6 have L-shaped projections at their lower ends, engaged by the enlarged portion of disk q^2 and by which they are, each one, after being raised, returned to their normal position shown in the drawings. Springs r', eight in number, are secured to projections formed on supporting-bars q^8, also eight in number and having projections thereon supporting cam-plates q^6, and the core-rods q^5 passing through holes therefor in the projections formed on the lower ends of such cam-plates and preventing springs r' from being pushed outward by the stronger springs r on disk q^2 as the same is raised by rod Q^3. These supporting-bars q^8 are secured to under side of plate N^2. The manner of notching out these washers n^3 is as follows, viz: First, all of them are placed in their normal positions; then starting at any one notch in plates N′ N^2 some one combination of three each of these eight washers n^3 is turned around to the right by lifting their corresponding cam-plates q^6; then all of these washers n^3 are notched out down to a straight line with the notches at that point in plates N′ N^2, so that bottoms of such notches in the plates and washers shall lie in a straight line; then all the washers n^3 are returned to their normal positions and a different combination of three thereof treated in the same way for the next notch in plates N′ N^2, and so on until all of the notches have been milled out in this way, whereby it will be seen that for each combination of three each of washers n^3, being turned by raising cam-plates q^6, one and only one of bars N^4 will be allowed to pass into the bottoms of notches therefor in plates N′ N^2. In Figs. 7 and 8 there are shown such parts only of my stitching apparatus as are necessary to illustrate the construction and operation of each part, while all unnecessary parts are removed. The bars and levers N^4, N^5, N^6, and N^7 are so jointed together that from the nature of the joints they naturally assume the positions indicated in the drawings and prevent levers N^6 from falling any lower than shown. In this way each of the bars N^4 is lightly pushed inward by gravity against the periphery of washers n^3. These washers n^3 have their extreme peripheries arranged so as to form the frustum of a cone, such that the bars N^4 shall bear equally against them all, and this pressure, while insufficient to prevent the movement of the washers n^3 three at a time by their cam-plates q^6, is yet sufficient to cause the bars N^4 to enter the grooves in washers n^3 when aligned for their reception.

It has already been explained how that, by my automatic current-distributer and its connections and by means of receiving appara-

tus such as shown and already described, for each transmitted impulse either one or neither one of two suitably-arranged coils may be energized and retained in its energizing-circuit. Whence it follows that by means of four impulses any desired combination of eight coils, taken three at a time, may be so energized and retained, and that by means of eight impulses two such combinations may be selected in two different series of eight coils each. Let, then, the solenoids q, eight in number, stand for one series of eight of such coils, and let d^6 represent an armature, actuated in any of the methods already shown by the fourth transmitted impulse, or at the time of such impulse, at which time also one of the above-named combinations of the solenoids q will of course have been energized, then armature d^6 being caused to occupy and retained in the position indicated in the drawings, the current of battery L B^4 will be caused to traverse solenoid Q^2, and in so doing taking the following course, viz: Wire 49, solenoid Q^2, wire 48, armature d^6, lower contact-pin of armature S′ of permanent magnet S, shown in contact therewith,) and wire 46, back to battery L B^4, thereby raising core-rod Q^3, disk q^2, springs r thereon, pushing out three of the springs r' when the rods q^5 have been raised, and thus engaging the corresponding cam-plates q^6 and raising them and turning to the right three of the washers n^3, and allowing one of the bars N^4 to swing inward to the position indicated in dotted lines and carrying with it the horizontal lever N^7, pivoted at the lower end thereof. Lever N^7 is connected with the contact-bar N^6, pivoted near the upper end of bar N^4, by means of connecting-rod N^5. This core-rod Q^3 also carries with it disk q^3 to the position q^4. (Indicated in dotted lines.) This disk q^3 has thereon the arm q^7 with projections formed near its lower end engaging armature S′, so that when disk q^3 is carried upward it moves armature S′ to the position shown in dotted lines against its upper contact-pin, connected by wire 65 with one end of solenoid Q′, the other end of which is connected by wire 49 with battery L B^4, while wire 46 connects the other side of this battery with armature S′, thus causing core-rod Q^3 to return to position shown in drawings, and in so doing disk q^3 by engaging lever N^7 has forced contact-lever N^6 upward to the position indicated in dotted lines and in contact with contact-springs s s, where it is held by spring s'. After disk q^3 has acted upon lever N^7, then disk q^2 by its enlarged portion forces downward to their normal position such of cam-plates q^6 as have been raised by the upward movement of rod Q^3, and thereby returning to their normal positions all of the notched washers n^3, the beveled or inclined surfaces on the back sides of the notches in these washers carrying or forcing out to its normal position that one of bars N^4 which has been allowed to swing inward. When it is desired to disengage contact-lever N^6 from contact-springs s s, then four induced impulses only are sent to line and armature d^6 being actuated at the time of the fourth impulse, and rod Q^3 is raised without moving any cam-plate q^6 or washer n^3, and hence no contact-bar N^6 will be moved, but that one occupying a working position (indicated in dotted lines) is disengaged and moved therefrom to its normal position by disk q' engaging the inner end of such bar N^6. A spring-switch x^2, whose use has already been explained, is opened by means of a projection on upper surface of disk q' when rod Q^3 is raised.

It has already been mentioned that that modification of my current-distributer shown in Fig. 3 should be used at a central station in connection with my automatic switching devices. These switching devices, as before stated, are in duplicate—that is, there are two of them exactly alike, except that while the contact-bars N^6 are arranged to engage thirty-two springs s s in one in the other each bar N^6 may engage only one spring s, but in other respects they are exactly alike and operated in exactly the same way. For operating these switching devices, I make use of the arrangement shown in Fig. 1ᵇ, showing only in outline the contact-pieces for the spacer-key and their connections. By means of switches S^{11} and S^{13}, connected respectively with contact-pieces m' and m^3, either one of such contact-pieces may be connected with either or neither one of wires 14 and 15, while in the same way, by means of switches S^{12} and S^{14}, contact-pieces m^2 and m^4 may be connected with either one or neither one of wires 17 and 18. Three only of the switches S^{11}, S^{12}, S^{13} and S^{14} are moved so as to send battery impulses to line by the depression of the spacer-key. By moving these switches in different combination thereof of three each different bars N^6 may be selected and operated in the central-station switching apparatus.

Two depressions of the spacer-key, it will be understood, are required, one to control each section of my automatic switching device at the central station, and for each depression that combination of switches S^{11}, S^{12}, S^{13}, and S^{14} is made, which shall cause to be energized, in the manner already described, the desired combination of solenoids q, thus selecting the desired bar N^6 in each switching apparatus.

For a fuller explanation of the apparatus and connections at a central station equipped according to my invention, reference is made to Fig. 18 and the plan of lettering therein shown. It has already been explained how that impulses on line M L, traversing relays I, J and K, cause the relays A^2 B^2 C^2 to H^2 to be energized or not, as desired, by strong or weak currents from battery L B′, and it has already been explained how that for each series of eight impulses on line M L, as desired, no one, any one, or any combination of two or more of such relays A^2 B^2 C^2, &c.,

may be so energized. There are two of each of these relays A^2 B^2 C^2, &c., arranged to be so energized in parallel, as seen, and also in parallel with relays D^2 and H^2 respectively a third relay D^6 and H^6.

A battery L B^2, by means of its connections with wires 4, 5, 75, 76 and 77, serves in the manner substantially the same as already explained to keep or retain energized in its own circuit such ones of relays A^2 B^2 C^2, &c., and relays D^6 and H^6 as have been energized from battery L B′ in the manner already described—that is, such as have been energized by currents from battery L B′—of sufficient strength to actuate their armatures. The upper horizontal row of relays A^2 B^2 C^2, &c., are adjusted to respond only to the stronger impulses from battery L B′, and the relays in the lower horizontal row are adjusted to respond to the weaker as well as the stronger impulses from this same battery. The lower armatures in each series of relays A^2 B^2 C^2, &c., are located in the retaining-circuits of the battery L B^2, while the upper armatures of each pair of the same letter are connected in series, whereby when connections are made with battery L B^3, such as indicated by lines 78 and 79, according as the lower one, neither one or both of these relays of each pair of the same letter throughout the series are energized, as desired, no one, any one, or any combination of two or more of the coils q may be energized from the battery L B^3; but it has already been explained in connection with Figs. 1ᵇ, 7, and 8 how that by means of the spacer-key and its connecting-switches such coils q may be energized in any desired combination thereof of three each in each of the series of eight thereof. As shown and already explained, relays D^6 and H^6 are energized, respectively, at the time of the fourth and eighth impulses on line M L, thus causing to be energized from battery L B^4, respectively, the coils Q^2 of the left and right hand sections of my switching apparatus and thus operating the already at that time selected lever N^6 of such left and right hand sections in the manner already explained in reference to Figs. 7 and 8, and as will be fully understood by comparison of the lettering in Figs. 7 and 18, and at the same time opening the switches x^2 in the retaining-circuits of battery L B^2 and thus restoring to their normal positions the armatures of relays A^2 B^2 C^2, &c., and D^6 and H^6.

In Fig. 18 only four local subscribers' circuits are provided for, each entirely isolated at each end from that of any other subscriber. They may be arranged thus, or as indicated in Fig. 9, resulting in the simplified construction of one-half of my switching apparatus, already described. It will of course be readily understood that any one of the local subscribers' stations connected by line M L to the central station may select and call up any other subscriber's circuit and automatically connect therewith.

In practice each one of the local subscribers' stations is normally in its own local circuit only and is disconnected therefrom and is connected with line M L by means of switches in the manner already well known in the art, and hence calling for no further illustration or description.

Referring to Fig. 9, let N^{6a} and N^{6b} represent the bars N^6 respectively of the first and second sections of my switching apparatus, and M L the main line, in which switch S^3 is normally moved to the right from the positions shown in the drawings, passing through coils of relays I, J and K and then to ground, as indicated. The desired bars N^{6a} and N^{6b}, say the ones to the left in each case, having been selected and operated in the manner described, switch S^3 is moved to the left, as seen in the drawings, either by the central-station attendant or in a manner similar to spring-switch x^2 by the second switching device, thus forming a shunt-circuit around the coils of relay I and at the same time causing the main line to pass through wires 50 and 51 and through the receiver z of the subscriber on that circuit. Only four of the bars N^{6b} and only a part of four only of bars N^{6a} are seen; but from what is shown and the plan of lettering adopted it will be seen that sixteen different local subscribers' circuits are provided for and that when thirty-two bars such as N^{6a} and also thirty-two such as N^{6b} are used then one thousand and twenty-four different local subscribers' circuits may be provided for. At the completion of a message to a local subscriber switch S^3 is again moved to the right and contact-bars N^{6a} and N^{6b} returned to their normal position in the manner already described. There are also contained in each subscriber's circuit other receiving-coils t', the effect of the main-line impulses thereon being neutralized by balancing-coils t, also located in such circuit. Any two such receiving-coils may be connected together by means of wires 88 89 and switch S^2, and communication carried on between two local subscribers independent of the main-line impulses, and that, too, while either one is receiving a main-line message, the effect of main-line impulses on coils t' being neutralized by the balancing-coil t, through which the main-line impulses are also caused to pass. Obviously, still further connections are required in the case of subscribers whose circuits are in no wise connected by my switching apparatus. In such cases the usual connections are made.

I have herein shown and described only one phase of my switching device adapted to be used in connection with that arrangement of my transmitting apparatus to be employed with that phase of my receiving and selecting apparatus shown in Figs. 2 and 4; but when that arrangement of my receiving and selecting apparatus shown in Figs. 3 and 5 is employed a modification of my transmitting devices is required, which is considered too ob-

vious to call for further illustration and description. In this case it will of course be understood that eight alternating transmitting impulses are sent from each key. It will be readily understood then that by locating at a central station one of my automatic current-distributers arranged for sixteen alternating impulses in each series and using the first and second eight of such impulses in each of such series to operate a first and second section of a switching device according to my invention each of the sections of such switching device may have one hundred and twenty switching-levers, whereby there may be controlled and selected directly by the depression of the different transmitting and shifting keys any desired one of fourteen thousand four hundred local circuits.

In the printing of messages telegraphically, I have found it desirable to dispense with inked ribbons and to use in place thereof inking-pads and direct printing mechanism. I have further found it is important to make use of as few keys as possible at the transmitting-station, and as few type or printing bars as possible at the receiving-station, in order to lessen the work of and apparatus for their selection and operation. Of course this necessitates the use of shift-keys, two of which I use in my system or apparatus and which has heretofore been objectionable on account of the heavy and cumbersome parts which such shift-keys have been used to control. To overcome these difficulties and objections hereinbefore mentioned, I have devised the apparatus shown in Fig. 10, to which reference is now made. O is a type-bar, bifurcated at its outer end and having revolubly secured thereon the small type-wheel O^2. This type-bar O is fixed upon a short shaft O^6 working in bearings. (Not shown.) Fitted revolubly upon this shaft O^6 is seen the double-armed lever O^4, presenting an exactly similar appearance upon both sides of the type-bar O, encircling the same at its upper right-hand or outer end, and constituting in effect two exactly similar levers with a solid connection at their right-hand or outer ends. Connecting-rods *o* articulate at their upper ends with the inner ends of lever O^4 and at their lower ends with type-wheel O^2, upon either side thereof, by means of a pin passing therethrough and near the periphery thereof.

The relative proportions and positions of the parts just described are such that when a type-bar is brought into its operative position O′, (indicated in dotted lines,) then connecting-rods *o* assume the position *o′*, (indicated in dotted lines,) and type-wheel O^2 has been caused to make about a half-revolution in the direction indicated by the arrow, whereby that type which was opposed to the center of the inking-pad P, (shown in vertical section,) is caused to strike the paper on platen O^3.

To prevent and overcome any tendency of type-wheel O^2 and connecting-rods *o* to catch and stop on dead-center, a pin o^{10}, working in a slot therefor through type-bar O, is secured at the proper point in connecting rods *o*.

It will be readily understood that by swinging lever O^4 on shaft O^6, by raising or lowering its right-hand end, a rotary motion will be communicated to type-wheel O^2, which, being properly adjusted in amount, will cause, as desired, the type on wheel O^2 immediately to the left or to the right of the one shown in printing position to occupy a printing position instead of that one.

A connecting-rod o^3 communicates motion from lever O^5, fulcrumed at or near its middle and articulating at its left-hand or inner end upon the rounded edge of the central flange formed on cylinder O^6 to lever O^4. Cylinder O^6 works loosely upon the enlarged portion of rod X^8, suitably supported in the center of my printer. On rod X^3 are secured washers o^6 and o^7, by means of which springs o^4 and o^5 are caused to press washers o^8 and o^9 against the upper and lower shoulders formed by the enlarged portion of rod X^8, whereby cylinder O^6 is normally held in the position indicated in the drawings. This position is maintained at all times during the printing of small letters. A lever X^9, fulcrumed at its angle, articulates with the projection formed on cylinder O^6 at its lower end. A curved core-rod X^{10} is secured to the lower end of lever X^9 and is moved to the right or to the left, thus lowering or raising cylinder O^6 according as solenoid X^2 or solenoid X′ is energized in the manner already described. Either of these solenoids, or neither of them, may be energized for each character transmitted. Hence any one of three characters may be printed at the operation of each type-bar O, of which there may be any desired number, preferably from twenty-six upward. A connecting-rod o^2 communicates to type-bar O motion from angular lever X^4, also fulcrumed at its angle and having secured to its lower end the curved core-rod X^5 working in the solenoid X^3. A contact-spring x^4 has at its right-hand end a downwardly-bent catch arranged to engage a similar catch, as seen, on the upper end of the armature x^5 to electromagnet X. This electromagnet X, when energized from the battery L B^3, in the manner already shown and described, attracts armature x^5, releasing spring x^4 and allowing it to spring against core X^5, as seen in the drawings, making electric contact therewith. Battery L B^3 is connected with spring x^4 and one end of solenoid X^3, while the other end of this solenoid is connected with lever X^4 at or near its fulcrum, whereby the current of battery L B^3 is caused to traverse solenoid X^3, drawing core-rod X^5 in to the right and thus operating type-bar O. An insulating projection x^3 at the left-hand end of core-rod X^5, when such core-rod has been carried in up to the end of its course, depresses spring x^4, causing it to engage armature x^5 and to be held thereby out of contact with core-rod X^5, thereby opening the circuit of solenoid X^3, allow-

ing the parts, except spring x^4, to return to the position shown in the drawings. A catch x^7, pivoted at its left-hand end and held by a spring, as seen, against the projection x^6 on lower end of lever X^9, is arranged, as indicated, to catch and hold thereby lever X^9 when carried to either extreme of its course, thus forming an automatic lock for the shifting devices. A slide X^7, working on rod X^8 and operated by lever X^6, articulating with lever X^4, is provided with a spring-catch x^8 for releasing catch x^7 from lever X^9 just after the completion of the operating-stroke of each type-bar and while slide X^7 is returning to its normal position. Slide X^7 also carries a pin x^{10}, opening and engaging spring-switch x^2, already described, just at the completion of the stroke of each type-bar. Thus it will be seen that the actuating-coils of each type-bar are held in their energizing-circuits until the type-bars have completed their operative stroke, and that the selecting devices used for selecting such coils are also retained in their energizing-circuits until the completion of the operative stroke of a type-bar.

It will also be understood by reference to Fig. 4 that, in that phase of my receiving apparatus therein shown, the branch relays A^{11} A^{12} to A^{19} are selected by the first two impulses taking one-half of the time required to transmit a character, whereby the actuating-coils selected by the transmission of any one character may take, for doing their work, one-half of the time used in transmitting the next succeeding character.

Referring to Figs. 10 and 11, my inking-pad P, circular in form, rests revolubly in a circular bed-piece P′, and consists of different sections p p, which may be inked in different colors. Angular adjustment of pad P may be secured by means of any suitable projecting pin or arm, as seen in Fig. 11. The sections p p may be removable so as to be inked independently. For the sake of securing more perfect alignment in my printer it is preferable to make every other type-bar a little longer than every intermediate one, whereby the shaft of such type-bars may be lengthened or elongated, as indicated in Fig. 12, only in outline.

I have shown the type-wheels O as full wheels with four sets of type on each. Only one arm or segment of a wheel can be used instead with only three type thereon for two shift-keys, or two characters for one shift-key and one character only where no shift keys or devices are used.

It should be noticed that no more time is required on the main line in my system to operate two shift keys or devices than would be required to operate one. Hence two are used with the corresponding simplification resulting therefrom. Attention is also called to the fact that by dispensing with inked ribbons, all ribbon movements are dispensed with and my printer is greatly simplified and the services and care of an attendant greatly lessened.

When it is desired to send several messages over the same wire at the same time, it is preferable to employ a system of synchronous multiplexy, but as every impulse on the main line has some effect upon the different parts of my receiving apparatus, I have found it necessary to make use of a special system of and apparatus for synchronous multiplexy. As a high rate of speed in synchronizing apparatus is objectionable and as a decrease in the rate of rotation means an increase in the number of distributer-sections calling for a corresponding increase in the number of correcting impulses to synchronize the sections, and as each impulse, as before stated, has some effect on my receiving apparatus, I have found it desirable to make each impulse a correcting impulse and have, for that purpose, devised the apparatus for synchronously multiplexing my system of telegraphy shown in Figs. 13, 14, 15, 16 and 17.

In my system I use a combined dynamo and motor. (Shown in side view and partially in section in Fig. 13.) In Fig. 14 there is seen in end view above the central horizontal line one-half of the armature V, and below this same horizontal line an interior end view of one-half of one of the field-magnets, while Fig. 15 shows the arrangement of the armature-sections and the field-magnet poles opposed thereto when arranged to be used as a constant-current motor, carrying upon the same shaft the synchronous transmitting-trailer and transmitting-dynamo nearly similar, but whose armature-sections and field-magnet poles opposed thereto are arranged as shown in Fig 17. Referring to Fig. 13, each field-magnet consists of an inner hollow cylinder R′, through the center of which passes shaft R^{11}, and upon which is wound the field-coil R^4 and inclosed within the outer cylindrical section R. These cylinders R and R′ have, on their ends opposed to the armature V, radial projections extending outward and forming a series of interlacing and alternating positive and negative poles, one opposed to each armature-section, as seen in Fig. 17, when alternating currents are to be produced or used in maintaining synchronism. These armature-sections V V′ consist of cores, preferably composed of bundles of fine soft-iron wire, alternate with each other, each having wound thereon a coil of insulated wire v^2, wound only on one-half or less of each section, the unwound portion of each section fitting in the spaces between coils on adjacent sections. All of the coils are connected in series, and there being an armature-section and coil for each field-magnet pole, there are as many impulses sent to line for each revolution of the armature as there are poles opposed to the armature, twenty-four being shown in the drawings. The terminals of the armature-coils pass to collector-rings R^9 and R^{10} of the usual con-

struction, with springs r^9 and r^{10} bearing respectively thereon. These armature-sections v and v' are supported upon a suitable hub R^{12} on shaft R^{11} and inclosed within a suitable retaining-cylinder V. For actuating such an alternating-current dynamo and the transmitting-trailer on the same shaft, any suitable mechanism may be employed, such as a modification of this same dynamo and motor, adapting it to use as a constant-current motor. In this case, as seen in Fig. 15, the armature-sections v v' are considerably shorter and alternate with each other in position so that every other one shall be opposed to a magnetic pole on one end and every intermediate one to a magnetic pole on the other end or side of the armature. In this case any two adjacent armature-sections are exposed to the same inductive action on opposite sides of the armature, causing adjacent coils in the same field to work together harmoniously or in unison. In this case also, as seen, the coils are shorter. They are all connected together in series and should make a similar connection to those made in the well-know Gramme armature and to an exactly similar commutator. Two or four poles may be used on each side of the armature.

In Figs. 13, 14, and 17 provision is made for twenty-four impulses at each armature revolution and accordingly for twenty-four divisions on the sunflowers. In Fig. 16, however, to avoid confusion, twelve divisions only are shown in each sunflower R^7 and R^8. Twelve armature-coils v^2 only are shown in diagram in this figure. Two sunflowers R^8 are shown, one at a transmitting-station to the left and one at a receiving-station to the right. Trailers R^5 and R^6 and springs r^5 and r^6 bear similar relations to and perform similar functions, respectively, to sunflowers R^7 and R^8. Sunflowers R^8 have their sections numbered 1, 4, 7, and 10 connected together and their sections numbered 2, 5, 8, and 11 connnected together and their sections numbered 3, 6, 9, and 12 connected together. The hub of transmitting-trailer R^6, (shown to the left in the figure,) carries four equidistant arms r^3, arranged to engage the carrying-pins on the automatic transmitting-rollers L^3, thus imparting to each of such rollers during each revolution of the trailer four impulses, causing it to advance a distance equal to the space of a perforation on the transmitting-ribbon. Any three adjacent sunflower-sections are connected with the shafts of these three rollers L^3, as seen, while the transmitting-contacts l^{14}, bearing on each roller L^3, are connected, as indicated by wire 91, to the battery M B^2 and therethrough to ground. Thus it will be seen that for each revolution of trailer R^6 there may be sent to main line M L, through spring R^6 connected therewith, from each one singly of rollers L^3 four impulses from battery M B^2. Sunflower R^7 has all its sections of odd number connected together and all its sections of even number connected together, and any two adjacent sections connected to the battery L B^5, while wire 94 connects the neutral point of this battery with one end of the primary of coil L^3, the other end of which wire 93 connects with spring r^5, bearing on hub of trailer R^5, revolving on same shaft with trailer R^6, as indicated in Fig. 13. It is preferable in place of induction-coil L^5, battery L B^5, sunflower R^7, and trailer R^5, to use my motor as a transmitting-dynamo. For this purpose connections are made, as seen by wires 99 and 100, with springs r^9 and r^{10}, thus sending to line from and through the coils v^2 v^2 the alternating impulses induced in such coils when used as dynamo-armature coils. Thus at each revolution of these trailers there are sent to line induced impulses alternating at each successive section of the sunflowers and also battery-impulses or not, as desired, harmonizing and synchronizing therewith, all as more fully explained hereinbefore, and illustrated in Fig. 1, for single transmission, and shown only partly of necessity and in diagram in Fig. 16.

In synchronously multiplexing the work of transmission according to my invention, the induced impulses alternating at each successive contact in distributer R^8 may be sent to line in the manner already described either from the armature-coils v^2 of my alternating-current-transmitting dynamo or from the secondary of induction-coil L^5, caused by the currents from battery L B^5 alternately positive and negative, being caused to traverse the primary of induction-coil L^5 by means of distributer R^7 and its trailer R^5 and the connections made therewith, already described. As each transmitting-ribbon and the contact-needles opposed thereto operate and are arranged in exactly the same way as already explained in reference to Fig. 1, I have shown them only in their outlines in Fig. 16. It only remains then to be explained how the induced impulses sent to line at the successive points of time in which any one ribbon, and more particularly the successive perforations therein, are brought into operative position and circuit are regularly alternating in kind, so that each ribbon used shall have its own distinct series of alternating impulses. Starting then with the several parts in the positions shown in Fig. 16 at the left at the sending-station, as trailer R^6 advances to its next contact to the right, connected only with the middle one of rollers L^3, one of the arms r^3 causes the left-hand one of rollers L^3 to revolve or advance a space of one perforation or one-fourth of a character on the ribbon carried thereby, and then in passing to the next contact connected only with the right-hand one of rollers L^3, one of these arms r^3 will cause the middle one of rollers L^3 to advance a space of one perforation on the ribbon carried thereby, and as trailer R^6 advances to still another contact connected only with the left-hand one of rollers L^3 at the same time one of the arms r^3 will cause the right-hand one of rollers L^3 to ad-

vance a space of a perforation on the ribbon carried thereby; and during the time that this trailer R^6 is on this last-mentioned contact the main line is connected to ground through the left-hand one of rollers L^3 and such one of the contact-needles bearing thereon as is opposed to a perforation in the ribbon carried thereby; and according to the location of such perforation there may be sent to line from battery M B^2 no impulse, or a weak or a strong impulse in the manner already described fully in reference to Fig. 1. This same action, just already described, takes place with regard to the central one of rollers L^3 during the time while trailer R^6 is on the distributer-contact next in advance of the one last mentioned, and the same also may be said with regard to the right-hand one of rollers L^3 during the time while trailer R^6 is in contact with that distributer-section next in advance of the one just last mentioned. In this manner the operation is continued throughout a whole revolution and each revolution of trailer R^6, each of the rollers L^3, during each revolution of such trailer, being caused to advance four times at regular intervals a space covered by one perforation in the ribbon carried thereby, and each being brought into operation four times in the manner described. It should be borne in mind that as there are three of these roller L^3 and as each one of them is placed in operative circuit four times during each revolution of trailer R^6, the induced impulses sent to line in either one of the methods already described, alternating at the successive points or contacts of distributer R^8, alternating also at the successive points in the revolution of such trailer R^6, on which any one of such rollers L^3 is placed in operative circuit, the same as though only one of such rollers L^3 were used and placed in operative circuit and caused to advance the space of a perforation in the ribbon carried thereby at each successive contact made by trailer R^6—that is, each of the rollers L^3 is placed in operative circuit at successive points in time in which a distinct series of alternating induced impulses is sent to line. Thus it will be seen that three separate and distinct messages are sent at the same time and that in each message a complete character is transmitted for each revolution of the trailer R^6. Spring r^6 of the receiving-distributer, shown to the right, is connected to the main line M L through the coils of relay W. The transmitting and receiving trailer being caused to revolve in the manner to be described synchronously, it will be seen that the impulses sent to line from the left hand, middle and right hand roller L^3 will be caused to traverse the left hand, middle and right hand series of relay-coils I, J and K, respectively.

Relay W is arranged to respond only to the induced impulses on the main line or only to the impulses sent to line by a transmitting-dynamo, whereby connections being made, such as indicated by lines 95, 96, 97 and 98, the current of battery L B^6 is caused to traverse field-magnet coils R^4 R^4 always in the same direction, and armature-coils v^2 v^2 of my receiving synchronizing-motor in a direction alternating at each alternation of the transmitted induced impulses. Thus it will be seen that each induced impulse is a correcting impulse controlling the synchronism of the receiving-trailer.

It should be borne in mind that armature w responds only to currents in one direction and armature w' only to currents in the opposite direction. It has already been explained how that relays I J K operated from the main-line impulses actuate and control the operation of the several parts of my receiving apparatus. These relays alone being actuated directly from the main line they constitute all that it is necessary to show of my receiving apparatus in Fig. 16.

The operation of the several features of my invention are believed to have already been sufficiently described in their proper connection.

The more obvious features of construction and operation have in some instances been omitted for the sake of brevity.

It will of course be understood that in transmitting the message, manual transmission, by means of my keyboard cannot be used at the same time with the automatic transmission by means of perforated ribbon L and the apparatus actuating the same and co-operating therewith. Each of such systems of transmissions—viz., the automatic and the manual—is used alone, independently of the other, never together for the same message. Either one may be used as desired. Attention is also called to the fact that the same system of selection is used for switching and for selecting coils X, but by means of devices differing for the different uses to which they are put.

What I claim is—

1. In combination with means for sending to line alternating induced impulses, means for sending to line or not, as desired, at each such induced impulse, a battery impulse synchronizing and harmonizing therewith.

2. In combination with means for sending to line alternating induced impulses, means for sending to line or not, as desired, battery impulses of different strength at each such induced impulse and synchronizing and harmonizing therewith.

3. A series of electric circuits or branch circuits, each containing a pair of relay contacts, means for causing a first impulse, traversing such first circuit, to open the contacts in such first circuit and close the contacts in such second circuit, and means for causing the second impulse thus traversing such second circuit to open the contacts in such second circuit and close the contacts in such third circuit, and so on, the impulse thus traversing the last circuit in the series, caus-

ing the contacts in such last circuit to open and the contacts in such first circuit to close, whereby in each succession of impulses, corresponding impulses are caused to traverse the same circuit or branch circuit.

4. A series of electric circuits or branch circuits, each containing a pair of relay contacts, means for causing a first impulse, traversing such first circuit, at its cessation, to open the contacts in such first circuit and close the contacts in such second circuit, and means for causing the second impulse, thus traversing such second circuit, at its cessation, to open the contacts in such second circuit and close the contacts in such third circuit, and so on, the impulse thus traversing the last circuit in the series, causing, at its cessation, the contacts in such last circuit to open and the contacts in such first circuit to close, whereby in each succession of impulses, corresponding impulses are caused to traverse the same circuit or branch circuit.

5. Two relay armatures having their actuating coils in the same circuit, one of such armatures having working contacts on each side thereof and responsive only to impulses of one kind or character, the other armature responding to impulses of the same kind and also to impulses of a different character not affecting such first armature, such second armature connected in series through its working contact with such first armature.

6. Two relay armatures having their actuating coils in the same circuit, one of such armatures having working contacts on each side thereof and responsive only to impulses of one kind or character, the other armature having working contacts on both sides thereof and responding to impulses of the same kind and also to impulses of a different character not affecting such first armature, such second armature connected in series through its working contact on one side thereof with such first armature.

7. Three relay armatures having their actuating coils arranged to be synchronously traversed by energizing impulses, the first armature having working contacts on each side thereof and responding to impulses of one kind or character, the second armature also having working contacts on each side thereof and responding to those same impulses and also to impulses of a different kind or character not affecting such first named armature, the third armature responding to impulses actuating either of the other armatures and also to impulses affecting neither of the other armatures, such second named armature connected through one of its working contacts in series with such first named armature and through its other working contact in series with such third named armature.

8. As a means for selecting and energizing any desired one of a number of coils, two or more branch relays each having its armature connected to a source of electric energy and arranged to engage two or more contacts, each contact connected to one terminal of a different one of such coils, all the similarly connected coils to such branch relays having their other ends connected to a common return wire, there being a return wire for each different coil and contact to a branch relay and means for energizing any desired one of such branch relays and for connecting to such source of electric energy any desired one of such return wires.

9. As a means for selecting and energizing any desired one of a number of coils, two or more branch relays each having its armature connected to a source of electric energy and arranged to engage or make contact with two or more contacts, each contact connected to one terminal of a different one of such coils, all the similarly connected coils to such branch relays having their other ends connected to a common return wire, there being a return wire for each different coil and contact to a branch relay and means for energizing any desired one of such branch relays requiring at least one half or more of the transmitted impulses necessary to select any desired one of such coils, and means for connecting to such source of electric energy any desired one of such return wires.

10. As a means for selecting and operating any desired one of a series of levers, a series of bars supporting and carrying such levers, a series of selecting washers opposed to such bars and having notches and projections so formed thereon, that the movement of such washers in each different combination thereof shall allow one and only one of such lever carrying bars to assume an operative position, causing its lever to assume an operative position such as to be engaged by a moving body arranged to communicate motion to such levers, in combination with means for actuating such selecting washers in such different combinations thereof.

11. In combination with any suitable rod or equivalent device, as Q^3, and means for reciprocating the same, a series of lever carrying bars, as N^4, carrying levers as N^7, a series of selecting washers, as N^3, opposed to such bars, means for operating such washers, N^3, in such different combinations thereof by the movement of such rod, as Q^3, as shall allow one of such bars and the lever carried thereby to assume an operative position, and means for actuating such lever by such rod Q^3.

12. In combination with any suitable rod or equivalent device, as Q^3, and means for reciprocating the same, a series of lever carrying bars, as N^4, carrying levers, as N^7, a series of selecting washers, as N^3, opposed to such bars, means for operating such washers, N^3, in such different combinations thereof by the movement of such rod Q^3, in one direction, as shall allow one of such bars and the lever carried thereby to assume an operative position, and means for actuating such lever by the return of such rod Q^3 to its normal position, and also for returning to their nor-

mal positions, after such lever has been so engaged, such lever carrying bars and such selecting washers.

13. At a central station a series of switch levers, each connected to main line and arranged to engage a single contact, each contact connected with a different series of wires from different local subscribers' circuits, each one of such local subscribers' circuits having its other end connected to a different contact opposed to a different switch lever, in a second series thereof, located also at such central station, and through which a ground or return connection may be made, as shown and described, common to all such local subscribers' circuits.

14. As a means for selecting any desired one of a series of circuits, a series of contacts each opposed to a different lever connected to one terminal of a different group of such circuits, each of the other terminals of such circuits in each of such different groups connected to a different contact opposed to a different lever in a second series thereof, and means for actuating such levers in the different combinations thereof forming terminals to the different circuits to be selected.

15. A series of type or printing bar actuating coils each located in a separate electric circuit or branch circuit, each closed through a spring contact normally operating, when once closed, to retain such circuit closed until the completion of the operative stroke of that type bar whose actuating coil is located in the circuit closed thereby, means for opening each of such spring contacts at the completion of the operative stroke of that type bar, having its actuating coil located in the circuit closed therethrough, individual devices for holding each of such spring contacts open, when once opened at the completion of the operative stroke of a type bar, each of such devices controlled by a separate coil, operating, when energized, to release such spring contacts, and means for selecting and energizing any desired one of such last named coils actuating the devices controlling such spring contacts.

16. A type bar having a revoluble type wheel in the printing end thereof, a lever swinging on or concentric with the axis of such type bar and a connecting rod between such lever and such type wheel.

17. A type bar having a revoluble type wheel in the printing end thereof, a lever swinging on or concentric with the axis of such type bar, a connecting rod between such lever and such type wheel, and means for swinging such lever so as to bring into printing position any desired one of such type on such type wheel.

18. In combination with a series of type bars having two or more type thereon, a shifting mechanism for each type bar, controlling the angular position of the type on such bar,—means for communicating motion from a common shifting device to each of such shifting mechanisms, a catch engaging such common shifting devices and means for releasing such catch at the completion of the printing stroke of any one of such type bars.

19. In a telegraphic system, at a transmitting station, a transmitting distributer and means for sending to line induced impulses alternating at the successive contacts thereof, and for superimposing thereon or not as desired transmitting battery impulses synchronizing and harmonizing therewith; at a receiving station, receiving instruments responding only to such battery impulses and a relay responding to such induced impulses and controlling a local circuit containing an alternating current electric motor, such motor containing an armature section and pole piece opposed thereto for each section or contact of such transmitting distributer, at such receiving station also a receiving distributer similar to the transmitting distributer and actuated from the shaft of such motor, and through the different sections of which successively such main line impulses are all caused to pass and thereby through the different ones as desired of such receiving instruments connected to different sections of such receiving distributer.

20. In a telegraphic system, an alternating current dynamo having its armature coils in the main line and having an armature section and pole piece opposed thereto for each section of a transmitting distributer located directly on, or actuated from the shaft of such dynamo, and means for sending to line or not as desired, through the successive contacts of such distributer, battery impulses harmonizing and synchronizing with such induced impulses from such alternating current dynamo.

21. In a telegraphic system, as a means for maintaining synchronism, at a transmitting station, a distributer and means for sending to line impulses alternating at the successive contacts thereof, and at a receiving station an alternating current electric motor having an armature section and coil for each contact of such distributer; and having its energizing circuit controlled by a relay on the main line responding to such alternating impulses, such motor imparting its motion to a receiving distributer or other apparatus to be synchronized.

22. As a means for selecting any desired one of a number of coils, a series of branch relays, each controlling two or more branch circuits containing a different one of such coils, all the similarly connected coils to such branch relays connected to a common return wire there being a different return wire for each coil to such branch relays, such branch relays connected to a source of electric energy, means for selecting and energizing such branch relays and for connecting to such source of electric energy any desired one of such return wires.

23. At a central station, a series of sub-

scribers' circuits, each terminal of each of such circuits entering such station, means for connecting such subscribers' circuits in different groups, at one end to a common ground or return connection and at the other end to a wire leading to a station outside of such central station, such that between such wire and such common ground or return connection an unbroken path shall lie through one only of such subscribers' circuits.

24. In combination with means for sending to line alternating impulses, means for causing any one of such impulses to be an induced impulse or a weak or strong battery impulse as desired.

25. A series of electric circuits or branch circuits, each containing one or more pair of relay contacts actuated by devices under the control of the successive impulses traversing such circuits or branch circuits, such that any impulse traversing any one of such circuits or branch circuits shall cause at its cessation the opening of that circuit or branch circuit just traversed and the closing of the next circuit in the series.

26. A series of electric circuits or branch circuits each containing one or more pair of relay contacts actuated by devices under the control of the successive main line impulses causing correspondingly successive relayed impulses to traverse such circuits or branch circuits, such that any one of such main line impulses shall cause at its cessation the opening of that circuit or branch circuit just traversed by a relay impulse and the closing of the next circuit or branch circuit in the series.

27. In a telegraphic system, at any one station therein, two receiving instruments or magnets, each located in a separate electric circuit or branch circuit, and in series with a separate pair of main line relay contacts, one pair of such relay contacts controlled by mechanism actuated by weak currents, the other pair of such relay contacts controlled by mechanism actuated only by stronger impulses, but not actuated by impulses sufficient to actuate the mechanism controlling such one pair of relay contacts, and a current distributer located between such main line relays and such receiving instruments or magnets, such distributer making connection with corresponding ones of a series of receiving instruments synchronously with corresponding main line impulses.

28. In a telegraphic system, at any station therein, two receiving instruments or magnets, each located in a separate electric circuit or branch circuit and in series with a separate pair of main line relay contacts, one pair of such relay contacts controlled by mechanism actuated only by positive impulses or currents, the other pair of relay contacts controlled by mechanism actuated only by negative impulses or currents, and a distributer located between such relay contacts and such receiving instruments or magnets, such distributer making connection with corresponding ones of a series of receiving instruments synchronously with corresponding main line impulses.

29. In a telegraphic system, at any station therein, four receiving instruments or magnets, each located in a separate electric circuit or branch circuit and in series with a separate pair of main line relay contacts, two of such pair of relay contacts controlled by mechanism actuated only by positive impulses or currents and the other two of such pair of relay contacts controlled by mechanism actuated only by negative impulses or currents, two pair of such relay contacts controlled by mechanism actuated by feeble or weak impulses or currents insufficient to actuate the mechanism controlling another two pair of such relay contacts, such last named two pair of such relay contacts controlled by mechanism actuated only by stronger impulses or currents and a distributer located between such relay contacts and such receiving instruments or magnets, such distributer making connection with corresponding ones of a series of receiving instruments synchronously with corresponding main line impulses.

WM. H. COOLEY.

Witnesses:
E. M. KNIFFEN,
H. A. METCALF.