E. C. MOLINA.

TRANSLATING AND REGISTERING APPARATUS.

APPLICATION FILED MAY 15, 1911.

1,089,426.

Patented Mar. 10, 1914.

3 SHEETS—SHEET 1.

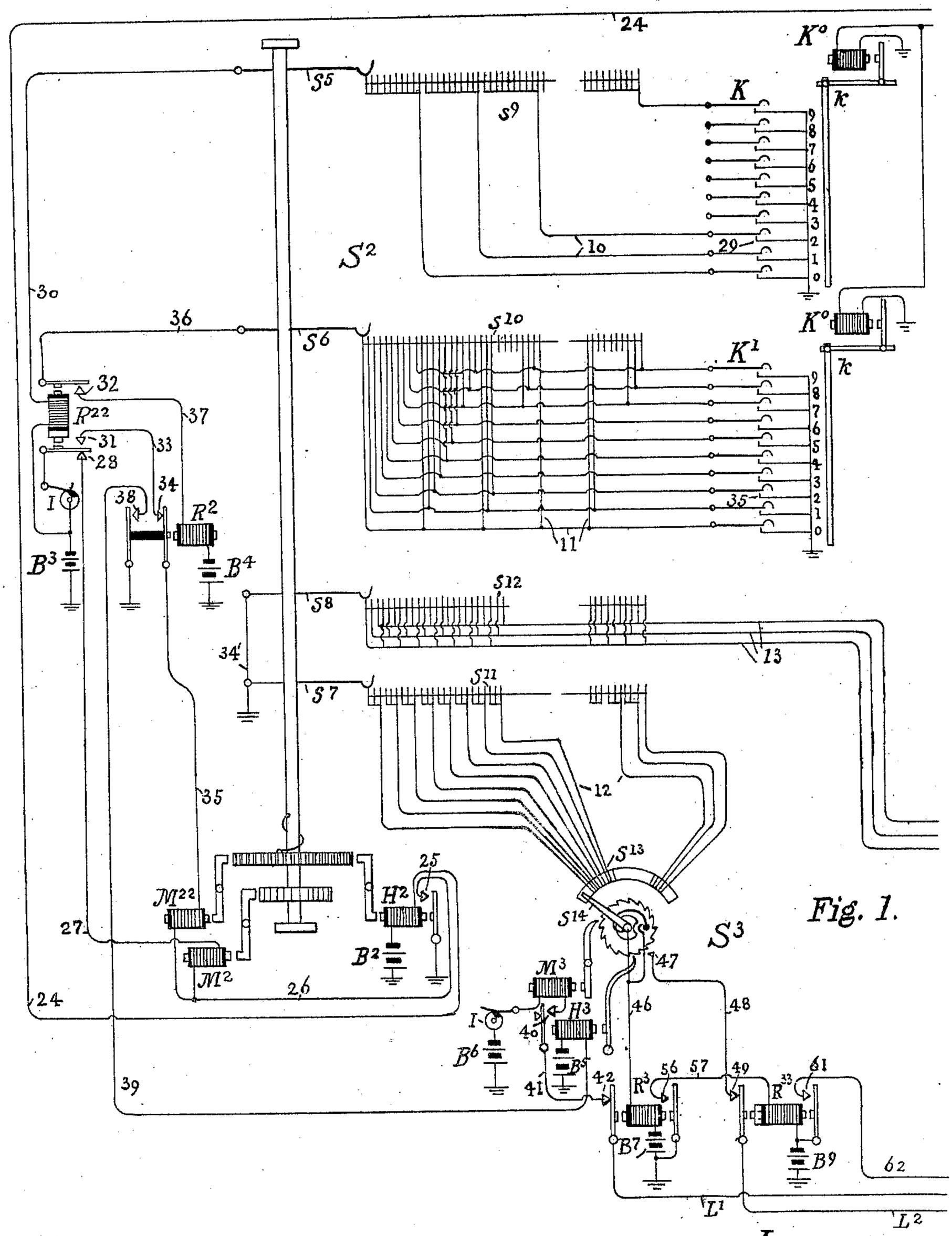

Fig. 1.

Attest,

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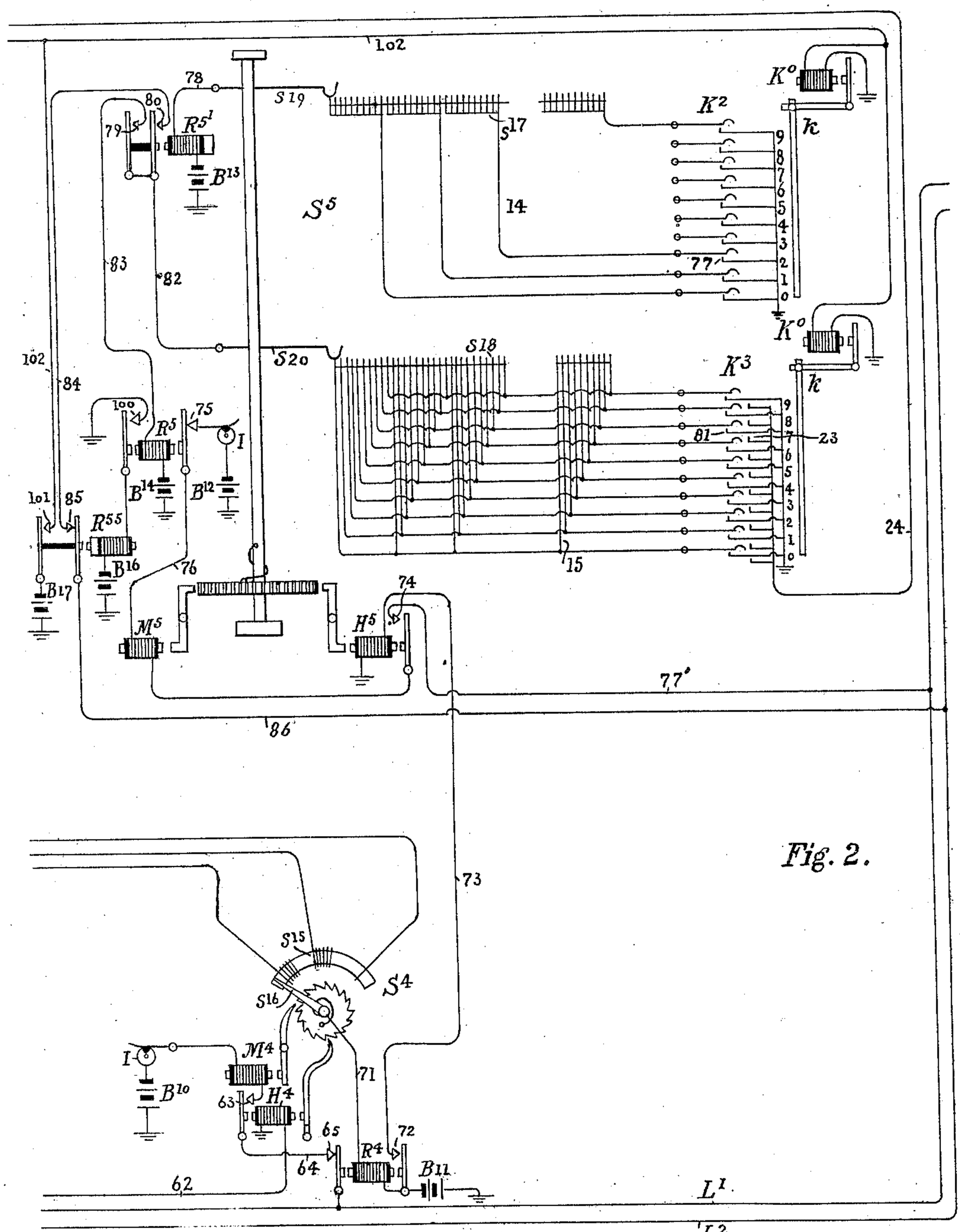

Fig. 2.

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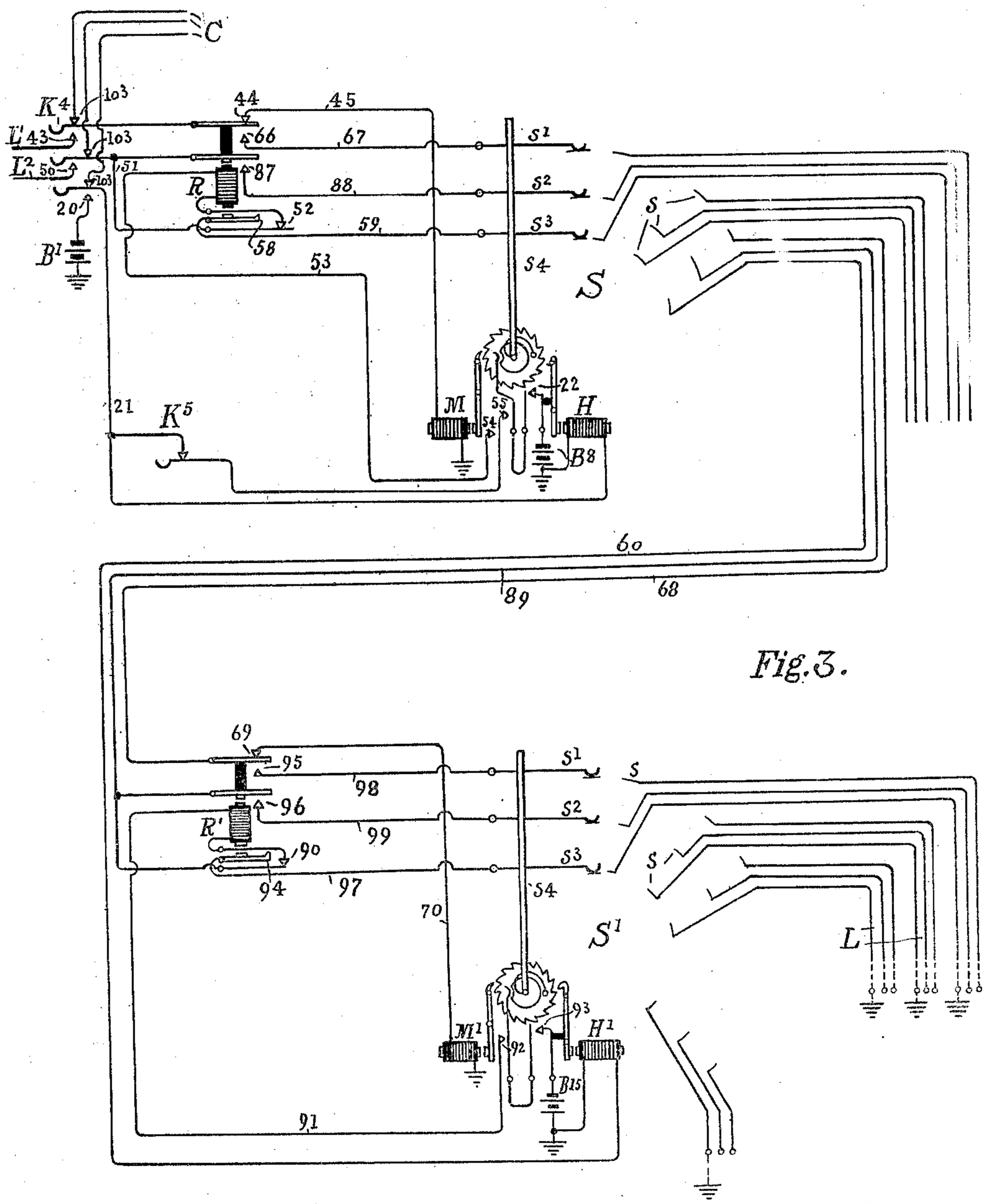

Fig. 3.

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UNITED STATES PATENT OFFICE.

EDWARD C. MOLINA, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TRANSLATING AND REGISTERING APPARATUS.

1,089,426. Specification of Letters Patent. Patented Mar. 10, 1914.

Application filed May 15, 1911. Serial No. 627,320.

To all whom it may concern:

Be it known that I, EDWARD C. MOLINA, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain Improvements in Translating and Registering Apparatus, of which the following is a specification.

My invention relates to what I term the "translation" of electrical conditions, being especially applicable to the automatic or mechanical selection of line terminals in telephone systems. Custom requires that telephone line designations be expressed in the decimal system of notation, but the demands of traffic and mechanical limitations often make it desirable to otherwise arrange trunk and substation lines.

This invention provides a comparatively simple system, with few mechanisms and with direct connections, for automatically registering and changing conditions initiated in accordance with one grouping to some other grouping, it being a particular embodiment of the broader invention set forth in my co-pending application Serial No. 312,858, filed April 20th, 1906.

The accompanying drawings show diagrammatically successive portions of the system, Figures 1 and 2 representing controlling apparatus including the register and translator, and Fig. 3 illustrating selecting apparatus.

As a particular embodiment of my invention, I will describe a partly manual, partly automatic telephone system, in which any one of ten thousand substation lines may be selected by automatic switches, such as appear at S, S^1 in Fig. 3 of the drawings, each having three hundred triple sets of fixed terminals s and coöperating line brushes s^1, s^2, and a third or test brush s^3. The switch S serves as a primary or group selector and the switch S^1 as a final selector or connector, the former first operating to pick out a non-busy final machine in the desired one of the thirty-four groups into which the ten thousand lines are divided in accordance with the number of terminals in each machine, there being thirty-three groups of three hundred lines each, and an additional group of one hundred lines. These selectors S and S^1 may be of any convenient type, they being illustrated conventionally as each having a shaft s^4 carrying the brushes, and rotatable to move said brushes over the terminals by ratchet mechanism actuated by motor magnets M and M^1, respectively. Pawls governed by magnets H and H^1 retain the brushes in the positions to which they are advanced. A return to normal position upon the deënergization of the magnets H and H^1 may be effected by suitable spring mechanism. Both switches have off normal contact devices and the retaining magnets other contact devices, which will hereinafter be designated by reference characters in tracing the circuits.

The apparatus for controlling the action of the selectors includes four sets of manually operable contact devices or keys, K, K^1, K^2 and K^3, there being ten in each set, corresponding respectively to the digits in the thousands, hundreds, tens and units places of the decimal system of notation, and upon which the numbers designating substation lines may be registered. Each set of keys, which may be spring actuated to hold their contacts or register elements normally separated, is provided with suitable locking mechanism k for the purpose of retaining them when depressed, this locking mechanism being controlled to bring about the release of the keys by an electromagnet K°. From what has been said of the arrangement of the substation lines, it will be seen that the operation of the decimal thousands and decimal hundreds keys must lead to the non-decimal selection of each of thirty-four groups of final selectors, and the further non-decimal selection of a particular hundred of the three in the first thirty-three of these groups. Having secured the desired hundred, selection proceeds decimally under the influence of the tens and units keys. To enable this to be accomplished, a translator is associated with the thousands and hundreds keys. This comprises a register switch S^2 having a shaft to which are fixed brushes or contact members s^5, s^6, s^7 and s^8, traveling over fixed terminals or contacts s^9, s^{10}, s^{11} and s^{12}, respectively, under the successive influence of long and short step motor magnets M^2 and M^{22} operating appropriate ratchet mechanism. A retaining mechanism controlled by a retaining and release magnet H^2 holds the brushes in position, and springs act to restore them, as in the selectors and other switches hereinafter mentioned. All the series of contacts occupy arcs of circles corresponding in extent to one hundred

single or elementary contacts with their intermediate spaces, or a distance covered by ninety-nine steps of the ratchet mechanism actuated by the motor magnet M^{22}. Each of the contacts s^9 in the first decimal group is equivalent to ten single contacts, there being ten in all, though here and in other switches of the system, some are omitted. They are consecutively joined by conductors 10 to the thousands keys K from zero to nine. Each contact s^{10} of the second decimal group consists of a single contact, and the first ten of these and every tenth thereafter are multiplied in groups of ten by conductors 11 leading to the respective hundreds keys K^1. The decimal contacts determine the setting of the register under the control of the thousands and hundreds keys.

The primary non-decimal group contacts s^{11} each includes three of the elementary contacts, except the last, or thirty-fourth, which is single, and from them conductors 12 lead to successive fixed contacts s^{13}, thirty-four in number, of a selection controlling switch S^3 adapted to transmit to the selecting apparatus the translated conditions registered at the bank s^{11}. The brush or contact member s^{14} of switch S^3 is caused to travel over the contacts s^{13} by a motor magnet M^3 and cooperating ratchet mechanism, while a retaining magnet H^3, by the application of a pawl upon its energization, prevents reverse movement. The secondary non-decimal group of single contacts s^{12} of the register are multipled in three sets by conductors 13, and joined to three contacts s^{15} of a secondary transmitting switch S^4, which is provided with a brush s^{16}, a motor magnet M^4 and a retaining magnet H^4. These contacts s^{15} are separated from one another by distances equivalent to one hundred steps of the switch S^4 under the influence of its motor mechanism, and determine the movement of the selecting apparatus to the beginning of some one of the hundreds in any of the thirty-four primary groups. The non-decimal register terminals, with the coöperating brushes, thus furnish contact means governing the travel of the transmitting switches and thereby controlling selection under the new grouping. The register and transmitting switches with their retaining magnets operate extra contacts, as will hereinafter appear.

Between the tens keys K^2 and units keys K^3 and the selecting apparatus, no register mechanism is interposed, since the terminal groups at the selectors are arranged in accordance with the same numerical system as the keys. The tens and units keys are therefore united directly by conductors 14 and 15, respectively, with decimal contacts s^{17} and s^{18} of a transmitting switch S^5. The length of the contacts and their connection with the keys may be exactly the same as the decimal contacts s^9 and s^{10} of the register S^2. The brushes s^{19}, s^{20} of the switch, its motor magnet M^5 and retaining magnet H^5 are also similar to those of the register, though it should be noted that the single magnet M^5 causes the advance of the brushes over the entire bank of one hundred contacts in short steps.

Included in the system are relays to vary the circuit connections as may be necessary; these comprise relays R and R^1 at the group and final selectors S and S^1, respectively; a relay R^2 and a sluggish release relay R^{22} at the register S^2; a relay R^3 and a sluggish operating relay R^{33} associated with transmitting switch S^3, and a single relay R^4 with switch S^4; while at transmitting switch S^5 is a relay R^5, a sluggish release relay $R^{5'}$ and a sluggish operating relay R^{55}. The conductors joining the various sections of apparatus, electromechanisms and elements constituting the system will not be separately described, but will be mentioned in proper order in following the operation, except it may be said that a calling line may be connected with the selecting apparatus through conductors C, which may be a portion of a cord circuit, and the normal contacts of a key K^4 manipulated by a central station operator, who also has a release key K^5, and who actuates the digit keys K, K^1, K^2, K^3 in accordance with the number of the called line, some of these lines appearing at L. When the key K^4 is actuated it disconnects the conductor C from the selecting apparatus and unites the latter to the operator's controller through conductors L^1 and L^2. Electrical energy is supplied to the system by a battery B, which appears at different points distinguished by different numerals affixed to the reference letter. When intermittent current is desired a pulsator or interrupter I is employed between the battery and electromechanism to be actuated.

In describing in detail the operation of the system, it will be assumed that the central station operator has received a call for substation line No. 2227. This falls in the eighth primary group of three hundred lines, said group beginning with No. 2100 and ending with No. 2399. The line of this number is, furthermore, in the second secondary group comprising lines 2200 to 2299, and is the twenty-eighth line in said secondary group. Therefore, by the depression of the third thousands key K, the third hundreds key K^1, the third tens key K^2 and the eighth units key K^3, it is necessary to cause the primary selector S to advance its brushes to the eighth of its thirty-four groups of terminals, and the final selector to move its brushes to the beginning of the second hundred of its entire series of three hundred terminals and then to the twenty-eighth terminal therein.

By throwing the key K^4, the operator temporarily associates the primary or group selector S with the controlling apparatus, and the retaining magnet H of said selector is energized by current flowing from battery B^1 through contact 20 of key K^4, conductor 21 and winding of retaining magnet H to ground. The magnet, upon the attraction of its armature, not only applies the retaining pawl, but also closes a contact 22 which will be of use later in the operation. The operator then depresses the proper digit keys, as previously indicated, the units key last. Contact 23 of the eighth units key K^3 closes a circuit from ground through conductor 24 and winding of the retaining magnet H^2 of the register S^2 to battery B^2. This magnet operates its pawl and completes at contact 25 a circuit from ground through conductor 26, winding of the primary or long step motor magnet M^2 of the register, conductor 27, back contact 28 of relay R^{22} and the interrupter to battery B^3. Each time the magnet is energized by the current impulses, the four brushes of the register are simultaneously driven over ten of the elementary contacts, corresponding to one of the contacts s^9. When two pulses have passed through magnet M^2, relay R^{22} is energized by a circuit from ground through contact 29 of the third thousands digit key K, conductor 10, third thousands terminal s^2, brush s^5, conductor 30 and winding of the relay R^{22} to battery B^3. Relay R^{22} then opens contact 28 and closes contacts 31, 32. The breaking of contact 28 prevents any further transmission of pulses through the winding of magnet M^2, while contact 31 causes current to flow from the battery B^3 and interrupter through conductor 33, back contact 34 of relay R^2, conductor 35, winding of the secondary or short step motor magnet M^{22}, conductor 26 and contact 25 of retaining magnet H^2 to ground. The operation of motor magnet M^{22} continues the movement of the register brushes in short steps from one single contact to another. When two pulses have traversed magnet M^{22}, relay R^2 is energized by the closing of a circuit from ground at contact 35 of the third hundreds digit key K^1, through conductor 11, the twenty-third contact s^{10}, brush s^6, conductor 36, contact 32 of relay R^{22}, conductor 37 and winding of relay R^2 to battery B^4. Relay R^2 breaks its contact 34 and cuts off current from the secondary motor magnet M^{22}. This movement of the register results in brushes s^7, s^8 placing ground from conductor 34′ upon the eighth contact s^{11} and the twenty-third contact s^{12}, the latter being the second in the eighth multipled group. The apparatus is now ready to control the operation of the group and final selectors S, S^1 by the translated conditions thus created.

Relay R^2, besides breaking its back contact 34, makes a front contact 38, thereby energizing retaining magnet H^3 of the primary transmitting switch S^3 from battery B^5 by way of conductor 39. Magnet H^3 applies its pawl and closes contact 40. Pulsatory current will now flow from battery B^6 through the winding of motor magnet M^3, contact 40, conductor 41, back contact 42 of relay R^3, main lead or conductor L^1, contact 43 of key K^4, back contact 44 of relay R, conductor 45 and winding of the group selector motor magnet M to ground. Motor magnets M^3 and M operate in synchronism until eight pulses have been transmitted. The brush s^{14} of switch S^3 thus arrives at ground placed on the eighth terminal s^{13} by brush s^7 and thereby establishes two circuits—one through conductor 46 and the winding of relay R^3 to battery B^7; and the other through off normal contact 47 of the transmitting switch S^3, conductor 48, back contact 49 to relay R^{33}, lead L^2, contact 50 of key K^4, conductor 51, normal contact 52 of relay R, winding of said relay, conductor 53, off normal contacts 54 and 55 of the group selector S and contact 22 of the retaining magnet H to battery B^8. Relay R^3, now energized, opens its back contact 42 and the circuit of motor magnets M and M^3, and closes contact 56, which energizes the sluggish operating relay R^{33} from battery B^9 through conductor 57. Meanwhile relay R disconnects its winding from conductor 51 and locks itself to ground through its front contact 58, conductor 59, brush s^3 of the group selector S, the corresponding terminal in the eighth group of the set selected, conductor 60 and the winding of the final selector retaining magnet H^1, energizing the latter.

Returning now to sluggish relay R^{33}, it will be seen that on breaking its back contact 49 lead L^2 is separated from the ground at the brush s^7 of the register, while by closing its front contact 61 it energizes the restraining magnet H^4 of the transmitting switch S^4 over conductor 62 from battery B^9. Magnet H^4 then closes contact 63, allowing current impulses to flow from battery B^{10} through the winding of motor magnet M^4 of the transmitting switch S^4, conductor 64, contact 65 of relay R^4, lead L^1, contact 43 of key K^4, front contact 66 of relay R, conductor 67, brush s^1 of the group selector and corresponding terminal, conductor 68, back contact 69 of relay R^1, conductor 70 and winding of motor magnet M^1 of the final selector switch to ground. The motor magnets of the transmitting switch S^4 and final selector will now operate synchronously until one hundred and one pulses have been transmitted. Then there will be a circuit from the ground at brush s^8 of the register, through the twenty-third

contact s^{12}, conductor 13, brush s^{16} of the transmitting switch S^4, conductor 71 and winding of relay R^4 to battery B^{11}. Thereupon relay R^4 severs at contact 65 the circuit of motor magnets M^4 and M^1, and by means of its front contact 72 energizes, by a circuit through conductor 73 from battery B^{11}, the retaining magnet H^5 of the transmitting switch S^5. Magnet H^5, by means of front contact 74, completes a circuit from battery B^{12} and its interrupter, through back contact 75 of relay R^5, conductor 76, motor magnet M^5 of switch S^5, conductor 77′, lead L^1 and then over a path previously traced to ground through the winding of the final selector motor magnet M^1. Motor magnets M^5 and M^1 will operate together until twenty-seven pulses have been transmitted. Upon the passage of twenty of said pulses the tens brush s^{19} will close a circuit from ground at contact 77 of the depressed tens key K^2 through conductor 14, the third terminal s^{17}, brush s^{19}, conductor 78 and the winding of sluggish release relay $R^{5'}$ to battery B^{13}. This energizes relay $R^{5'}$, closing contacts 79 and 80 in the circuit of the units brush s^{20}. When seven more pulses have been transmitted through the motor magnets M^5 and M^1, brush s^{20} reaches the ground placed on the twenty-eighth terminal s^{18} by contact 81 of the depressed units key K^3, and two circuits are thereby closed from conductor 82 through contacts 79 of relay $R^{5'}$, conductor 83 and winding of relay R^5 to battery B^{14}; and through contact 80 of relay $R^{5'}$, conductor 84, back contact 85 of sluggish operating relay R^{55}, conductor 86, lead L^2, contact 50 of key K^4, front contact 87 of relay R, conductor 88, brush s^2 and the eighth terminal group of selector S, conductor 89, normal contact 90 of relay R^1, winding of said relay, conductor 91, off normal contact 92 of the final selector S^1 and contact 93 of the retaining magnet H^1 to battery B^{15}. Relay R^5 in the circuit first traced breaks its back contact 75, thereby opening the circuit of motor magnets M^5 and M^1. Relay R^1 in the second circuit opens its contact 90, thereby disconnecting the winding of said relay from conductor 89, and closes its front contacts 94, 95, 96. Contact 94 locks the winding of relay R^1 from battery B^{15} to ground by way of conductor 97, final selector brush s^1 and its one hundred and twenty-eighth terminal, test conductor of the selected line L, numbered 2227, and the winding of the usual cutoff relay. Contacts 95 and 96 of relay R^1 extend conductors 68 and 89 through conductors 98 and 99 and final selector brushes s^1 and s^2 to the talking conductors of the desired line.

Considering again relay R^5, in addition to breaking contact 75 it closes contact 100. A circuit is thereby completed from battery B^{16} for sluggish operating relay R^{55}, which is energized, breaking contact 85 and making contact 101. The opening of contact 85 disconnects the grounded units key from lead L^2. Contact 101 closes the circuit of the key release magnets K° from battery B^{17} through conductor 102 unlocking each of the four depressed digit keys, which separate their contacts. This release of the keys indicates to the operator that the action of the controlling apparatus and the selection of the wanted line is complete. She then reverses the position of key K^4, which disconnects the controller from the group selector and reëstablishes at contacts 103 the circuits between said group selector and the cord conductors C, completing the connection between the calling and called lines. When the contact 23 of the released units key opens, it severs the circuit of the retaining magnet H^2 of the register switch. Relays R^2 and R^{22} fall back upon the loss of the grounds at key contacts 29 and 35, relay R^2 deënergizing the retaining magnet H^3. Switch S^3, and similarly the switches S^4 and S^5 with their associated relays, are successively permitted to resume their initial positions. The energization of the retaining magnet H of the group selector, and therefore the retaining magnet of the final selector, is maintained by a circuit from battery B^8 through releasing key K^5. At the termination of conversation the operator opens this key, and the selectors S and S^1 successively return to normal, releasing their relays.

I claim:

1. A translating electromechanism comprising terminals arranged according to one grouping, terminals arranged according to another grouping, contact members movable together over both groups of terminals, and motor mechanism common to the contact members of both groups and governed by the conditions of one set of terminals and thereby changing the condition originally existing at the other set of terminals.

2. An electrical translating apparatus comprising terminals arranged according to one grouping, terminals arranged according to another grouping, contact members cooperating with both groups of terminals, means common to all of said contact members for moving the same, manually operable devices for governing the movement of the contact members, and switch mechanism controlled by the position of the contact members.

3. A controlling apparatus comprising a series of manually operable contact devices having a definite grouping, an electromechanism having terminals connected and corresponding to the grouping of the manual devices, a movable member contacting with said terminals and contact means governed

by the movable member and forming therewith a unitary register structure, and a second electromechanism provided with terminals connected to the contact means and with a coöperating movable contact member.

4. A telephone switching system comprising selecting apparatus, a set of decimal keys, a register mechanism having corresponding terminals connected to the keys and a movable member coöperating therewith, contact means operated in the movement of said member, said terminals, movable member and contact means being parts of a unitary register structure and selection controlling mechanism connected with the contact means and provided with terminals arranged in non-decimal groups.

5. An automatic controlling apparatus comprising manually operable means having register elements arranged in one or more groups, a certain number in each group, automatic registering means provided with elements corresponding to said group or groups of said manual means and coöperating therewith to limit its movement, and other elements arranged in one or more groups, the number in one or more of said groups being different from said first-named number or numbers, said elements being parts of a unitary register structure, and selection controlling means governed by the last-named elements of the registering means.

6. An automatic controlling apparatus comprising manually operable means having register elements arranged in one or more groups, a certain number in each group, automatic registering means having elements corresponding to said group or groups, and other elements arranged in one or more groups the number in one or more of said groups being different from said first-named number or numbers, said elements being parts of a unitary register structure and selection controlling means governed by the last-named elements of the registering means.

7. A controlling apparatus comprising sets of decimal keys, register mechanism having decimal terminals, a brush coöperating therewith, contact means, and motor mechanism in common for actuating said brush and contact means, transmitting mechanism having non-decimal terminals, a coöperating brush and a motor magnet for the brush, circuits governing the motor magnet of the register and including the keys together with the terminals and brush of said register, and circuits for governing the motor magnet of the transmitting mechanism and comprising the contact means of the register and the terminals and brush of the transmitting mechanism.

8. A controlling apparatus comprising a series of manually operable devices provided with contacts arranged in one or more groups, a certain number in each group, an electromechanism having terminals connected to said devices, said terminals being arranged to correspond to the grouping of the manual devices and having other terminals arranged in one or more groups, the number in one or more of said groups being different from said first-named number or numbers and movable members mechanically united to move together and coöperating with said terminals, and a second electromechanism having a movable member and terminals connected to terminals of the first-named electromechanism, a movable member of said first-named electromechanism varying the condition of said second electromechanism to determine the travel of its movable member.

9. A telephone switching system comprising selecting apparatus, manually operable contact devices, a register mechanism comprising terminals connected to said contact devices, a movable contact member coöperating with said terminals and contact means mechanically united with and operated in the movement of said contact member, and a selection controller provided with terminals connected with the contact means of the register and also provided with a contact member coöperating with the controller terminals and serving to determine the operation of the selecting apparatus.

10. The combination with a set of keys, of a register mechanism having terminals connected to different keys of the set and provided with a brush movable over the terminals, and a selection controlling mechanism having terminals the electrical condition of which is governed by said register mechanism and a brush mechanically united to said first-named brush and traveling over the last-mentioned terminals under the influence of their electrical condition to control selection.

11. The combination with a set of keys, of register mechanism having terminals connected to different keys of the set and being provided with a brush movable over the terminals, other terminals and a contact member mounted to move with the register brush, and a selection controlling mechanism governed by the contact member of said register.

12. The combination with a set of keys, of a register mechanism having terminals connected to different keys of the set, a brush movable over the terminals, other terminals and a contact member mounted to move with said register brush, and a selection controlling mechanism provided with terminals connected to those of the register mechanism and with a circuit controlling brush coöperating with said terminals.

13. The combination with a set of keys, of a register mechanism having a terminal

connected to each key, a brush coöperating with said terminals, a motor magnet for said brush, circuits governing said motor magnet, other terminals associated with said register, a coöperating contact member mounted to move with the register brush, and a selection controller provided with terminals electrically connected to the last named terminals of the register, a brush coöperating with said controller terminals, and a motor magnet for the controller brush governed by the condition of said controller terminals.

14. The combination with a set of keys, of a register mechanism having a terminal electrically associated with each key, a brush adapted to move over said terminals, means controlled by any of said keys for moving said brush, contact means mechanically united with and operable in the movement of said brush, and an electromechanical selection controller governed by said register.

15. The combination with a set of keys, of a register mechanism having a terminal electrically connected to each key, a brush coöperating with said terminals, a motor magnet for said brush, circuits for governing said motor magnet and including the brush, a register terminal and a key, other terminals associated with said register and a brush mounted to move with the first-named brush over said terminals, a selection controlling mechanism provided with terminals and with a coöperating brush, a motor magnet for said mechanism, and controlling circuits for the motor magnet including terminals of the register and controlling mechanism and the brush of said controlling mechanism.

16. A translating electromechanism comprising terminals arranged according to one grouping, terminals arranged according to another grouping, a shaft, contact members carried by the shaft to move together over the terminals, and means for moving the contact members governed by the condition of one set of terminals and thereby producing at the other set of terminals a condition different from that existing at the first named set.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this tenth day of May, 1911.

EDWARD C. MOLINA.

Witnesses:
R. S. SUTLIFFE,
FREDERICK W. GALWAY.