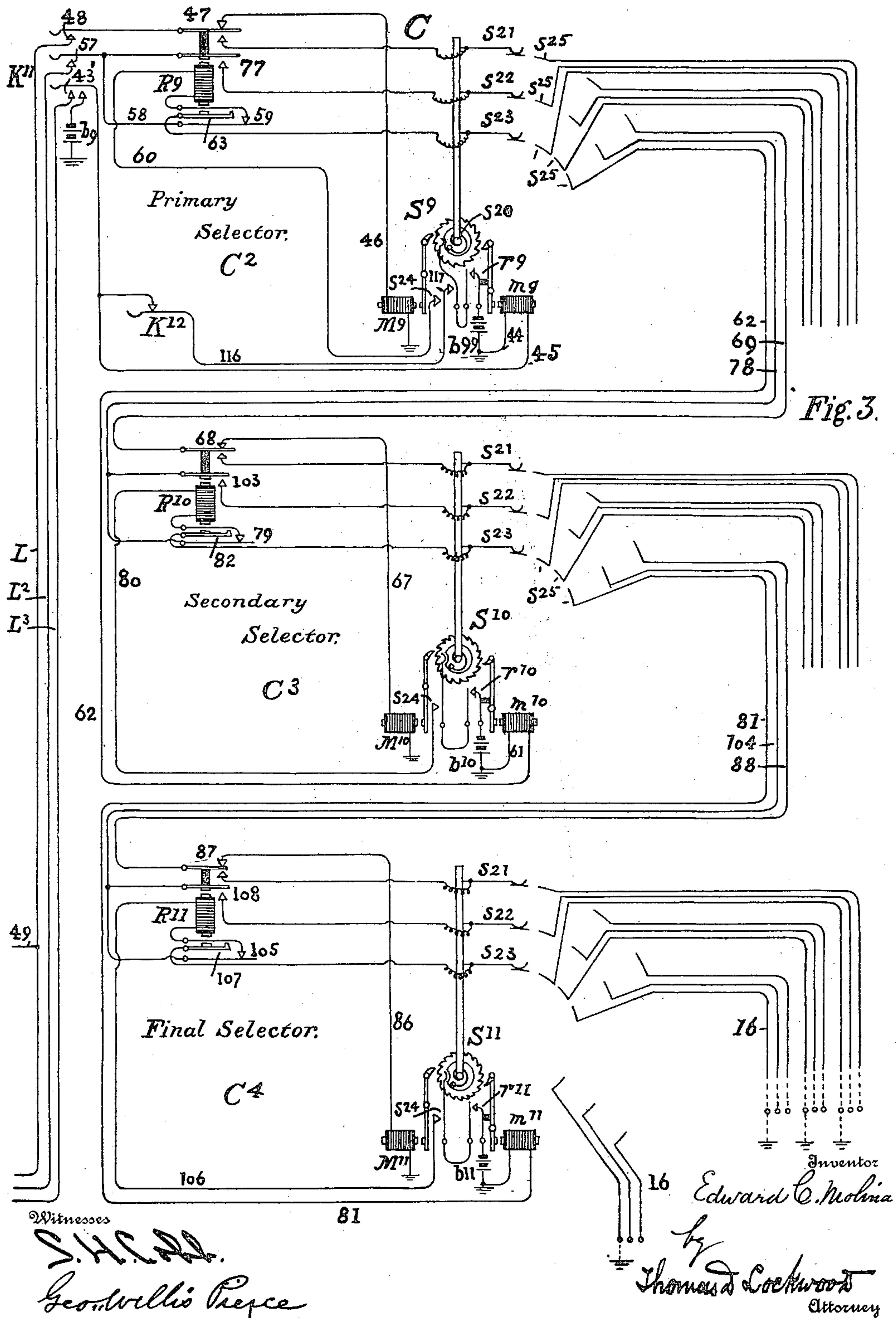


E. C. MOLINA.
TRANSLATING AND SELECTING SYSTEM.
APPLICATION FILED APR. 20, 1908.

1,083,456.

Patented Jan. 6, 1914.

3 SHEETS-SHEET 3.

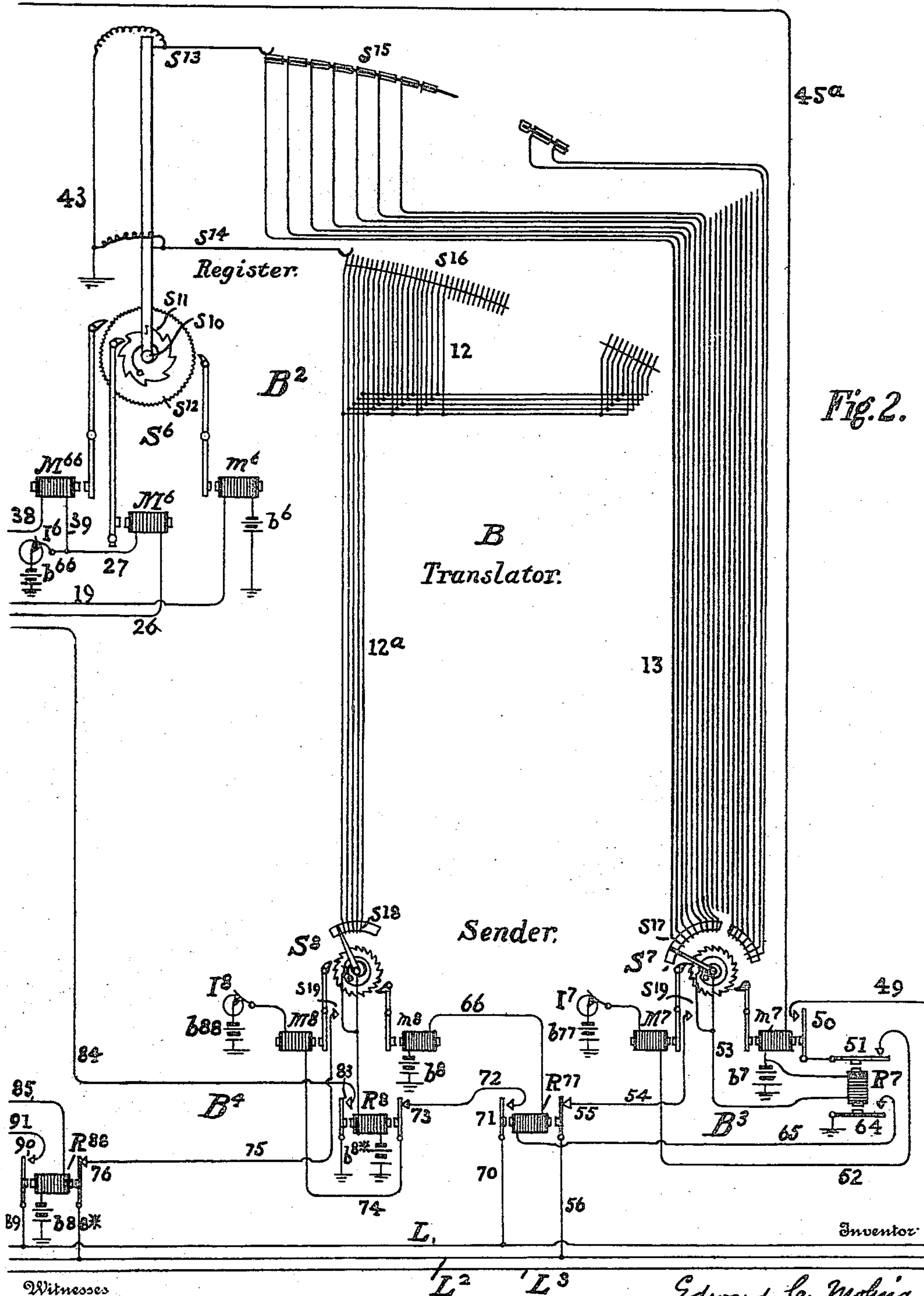


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3 SHEETS—SHEET 2.



Witnesses

S. H. Cobb
Gro. Willis Pierce

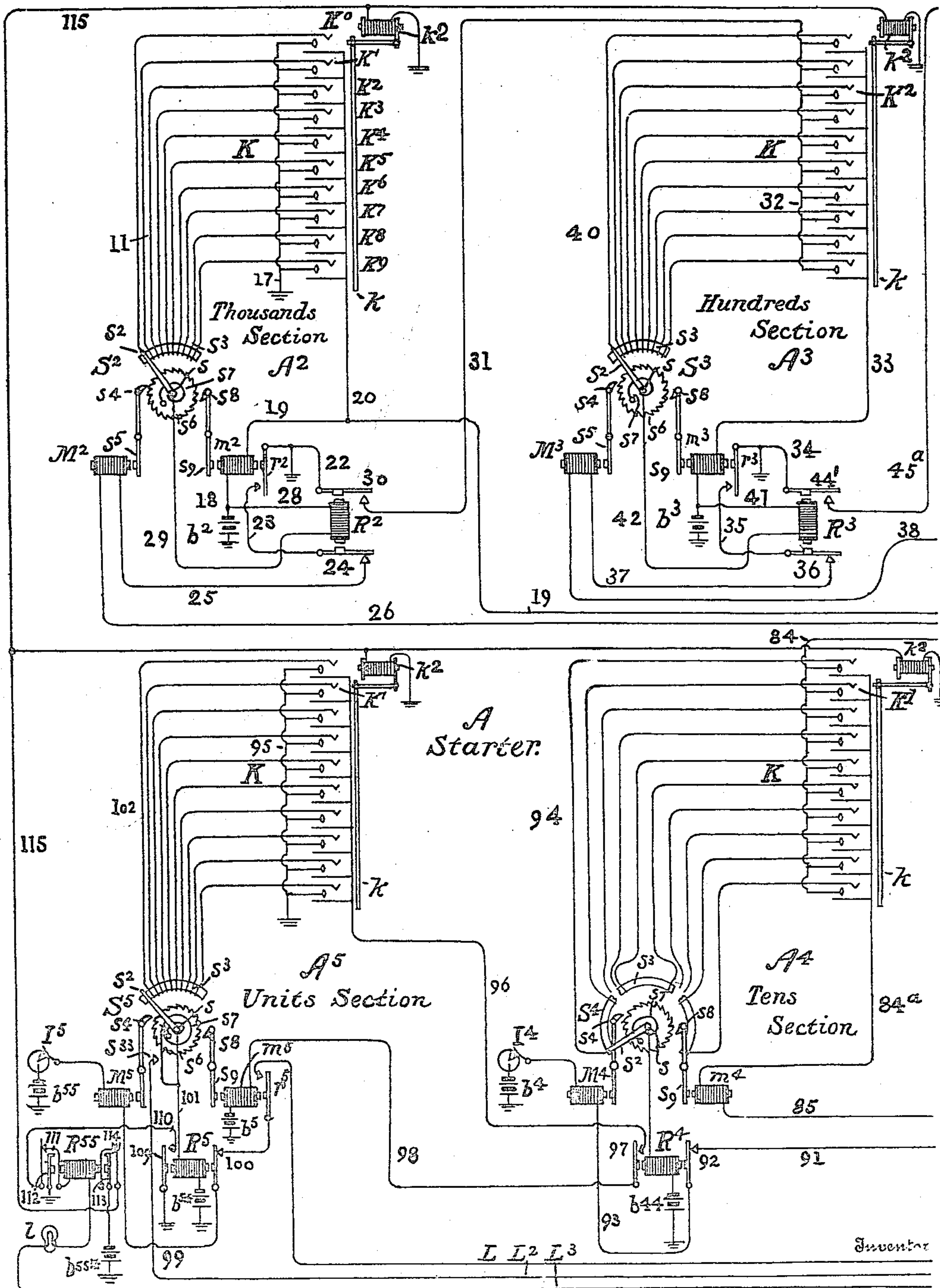
Edward C. Molina
Thomas J. Lockwood
Attorney

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3 SHEETS—SHEET 1.



Witnesses

S. H. Call
Geo. Willis Pierce

Fig. 1.

Edward C. Molina
by
Thomas D. Lockwood
Attorney

UNITED STATES PATENT OFFICE.

EDWARD C. MOLINA, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TRANSLATING AND SELECTING SYSTEM.

1,083,456.

Specification of Letters Patent.

Patented Jan. 6, 1914.

Application filed April 20, 1906. Serial No. 312,858.

To all whom it may concern:

Be it known that I, EDWARD C. MOLINA, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Translating and Selecting Systems, of which the following is a specification.

This invention relates to the selection of electrical circuits involving a change from one system of designating or grouping said circuits or associated apparatus to some different system

It is more particularly applicable to the mechanical selection of such lines as those employed in telephonic transmission.

The symbols used to identify telephone-lines, whether they be those connecting substations with a central station or trunks extending between said central stations or internal divisions thereof, are commonly numerals, and this notation naturally follows the decimal system. But, though this relation lends itself most readily to the identification of circuits or apparatus, their grouping in tens or powers of ten does not always secure the most effective or economical arrangement. For example, considering telephone-lines, and associated means at a central station for mechanically connecting them with one another, in accordance with the calls of subscribers, by means of machines possessing a greater number of fixed terminals, say, than one hundred, but less than one thousand, this next decimal group not being feasible in practice, larger groups of trunks may be appropriated to the use of a definite number of subscribers than if a hundred-point machine were employed. On account of such greater trunk-groups which it is possible to use with the larger machines the efficiency of the machines themselves is increased. This follows because the greater the trunk-groups the greater the efficiency per trunk, since the number of simultaneous calls from a fixed group of subscribers during a given time interval increases in a decreasing ratio as the size of the group of subscribers is increased. Obviously this is true, since there may be, for example, one call from a group of one hundred subscribers in any interval, yet from a group of three hundred subscribers but two and a fraction calls might fall in the same interval. Therefore it may become desirable to employ such connecting mechanisms having

more than one hundred and less than one thousand terminals, or with said terminals grouped upon some other non-decimal system. The cost of machines and their capacity for effective operation also modify this question of numerical arrangement. This merely gives an instance of certain conditions which this invention is adapted to meet, its principal object being the more general one of providing for the alteration of electrical conditions which may be represented by some numerical grouping, into conditions expressible by another numerical arrangement, or what may be termed their "translation."

The invention therefore consists in a system for thus translating electrical conditions and for making use thereof in the selection of circuits such as telephone lines.

In the form of the invention which I have chosen to here illustrate and describe, this change of condition takes place in electrical impulses which are transmitted.

In the accompanying drawings is shown a diagrammatic view of one embodiment of this improved translating system, adapted for use in connection with telephone-lines, though it is to be understood that this is but one of its possible applications. The figures of the drawings show successive portions of the system, Figure 1 illustrating the starting apparatus; Fig. 2 the translating apparatus; and Fig. 3 the selecting apparatus.

The more essential features of the organization comprise a starter or transmitting apparatus designated as a whole by A, by which a series of initial impulses of electricity may be sent in accordance with the original numerical grouping; a translator B, by which the impulses are rearranged in accordance with the new grouping, and a selecting apparatus C, which, while having a portion of its constituent parts based upon the translated grouping, will finally connect itself with terminals designated by the original system of numbering.

In the present instance a case has been assumed in which it is desired to deal with original numbers upon the decimal system up to ten thousand, and that the aggregate decimal group of ten thousand is to be translated into twenty primary groups of five hundred units each. Then, since this also destroys the decimal relation of the hundreds of the primary groups, it becomes

necessary to translate them into secondary groups, these being chosen in the present instance as of one hundred units each. The relation of the tens and units groups has not been altered, though obviously this might also be done, or the thousands and hundreds disposed in a manner other than that arbitrarily selected. For such an arrangement the starter or initial-impulse transmitter includes four sections, that designated by A^2 corresponding to the thousands digits, while A^3 , A^4 and A^5 include, respectively, the hundreds, tens and units digits. Each of the transmitting-sections has an electro-mechanical switch, these being lettered S^2 , S^3 , S^4 and S^5 , which may be of any convenient type. Each switch is here shown conventionally as being provided with a shaft s , a wiper or contact-arm s^2 and ten fixed contacts or terminals s^3 . It should be noted that these contacts s^3 in the tens-section are separated by ten times greater angular distance than are those of the other sections; a portion of them, however, being omitted. The switch S^5 is also shown as provided with an off-normal contact s^{33} which is closed by appropriate mechanism when the contact-arm is in other than its initial position. The shaft and contact-arm of each switch is rotated in operation by a pawl s^4 pivoted upon an armature s^5 and co-operating with a ratchet-wheel s^6 fast upon the shaft. The armatures are actuated by motor-magnets, these magnets being designated by the characters M^2 , M^3 , M^4 and M^5 in the thousands, hundreds, tens and units sections, respectively. Each contact-arm is normally held in its zero position by a spring s^7 secured to the shaft and to a relatively fixed point, but is temporarily retained in the position to which it is advanced by the motor-mechanism by means of a pawl s^8 carried by the armature s^9 of one of four holding-magnets m^2 , m^3 , m^4 and m^5 . The contacts s^3 are each electrically connected with a series of starting members furnished by ten keys K , each of these keys having a double contact and being designated by the digit it represents. The keys may be of a form well known in the art, in which springs hold their contacts normally open, any of the keys being temporarily retained in its depressed position by some such device as a spring-pressed bar k common to the keys of each series. A magnet k^2 coöperates with each bar and when energized moves it sufficiently to release any depressed key. Included in the starting sections A^2 , A^3 , A^4 and A^5 are controlling-relays R^2 , R^3 , R^4 and R^5 , respectively, while the holding-magnets of the sections A^2 , A^3 and A^5 also act as relays, they respectively operating contact-controlling armatures r^2 , r^3 and r^5 . As an adjunct to the units section A^5 , is a somewhat slug-

gish disconnecting or releasing relay R^{55} having in circuit with its winding a signal-lamp 1.

Associated with the system is a battery or other source of electrical energy grounded or connected to a common return-conductor, in circuit with which is an interrupter of any desired periodic type by which impulses of current may be produced. Though the battery and interrupter would in practice usually in a manner well understood be common to the entire organization, for convenience in following the circuits a plurality of each has been illustrated and will be hereinafter designated by different characters.

In conformity with the plan of regrouping previously mentioned, the thousands and hundreds sections of the starter A are directly connected with the translator B by conductors 19, 26, 38 and 45^a. Said translator comprises a register or receiving portion B^2 upon which the original impulses are impressed and primary and secondary sending or transmitting portions B^3 and B^4 by which the re-arranged impulses are forwarded to the selector. The register includes a switch S^6 which may be similar in structure to those of the starter, but its shaft s^{10} carries two ratchet-wheels s^{11} and s^{12} of different diameter and having teeth differing in pitch, which are engaged by pawls carried by the armatures of a primary or thousands motor-magnet M^6 and a secondary or hundreds motor-magnet M^{66} . The ratio of the dimensions of the ratchet-wheels s^{11} and s^{12} and the strokes of the coöperating pawls is such that the angle of rotation of the switch-shaft due to a single movement of the former is ten times that resulting from a corresponding movement of the latter. A holding-magnet m^6 operates through its armature and pawl upon the ratchet-wheel s^{12} as in the starting switches.

Fixed to the shaft s^{10} and insulated therefrom are primary and secondary contact-arms s^{13} and s^{14} operating over circumferentially-arranged series of fixed contacts or terminals s^{15} and s^{16} , respectively. There are twenty of these fixed contacts in the primary series and one hundred in the secondary series though a portion of each are here omitted, the former s^{15} , presenting five times the length of contact-surface of the latter, and all being insulated from one another. The contacts s^{16} are multiplied together in twenty sets of five each by conductors 12. It will be seen that the twenty primary contacts thus correspond in number to the groups of five hundred units contained in ten thousand, while the five contacts in each of the twenty sets of multiplied secondary contacts agree, respectively, with the five sub-groups of one hundred units in

each of the twenty chief groups. Now, since each consecutive five of the secondary contacts equals in effective extent one of the primary contacts, and assuming the contact arms s^{13} and s^{14} to lie in the same plane, it will be seen that no matter upon which of the twenty primary contacts the arm s^{13} is situated, by the same amount of angular movement the arm s^{14} may be brought to rest upon a secondary contact which, by its multiplying, may be subjected to the same circuit conditions. The utility of this will appear later.

Proceeding now to the sending or transmitting portion of the translator, the primary and secondary apparatus have switches S^7 and S^8 respectively, of substantially the same character as those of the starter A. These switches S^7 S^8 are actuated and locked through such ratchet mechanism as has been previously described, having motor-magnets M^7 and M^8 and holding-magnets m^7 and m^8 , respectively. The fixed contacts or terminals of these switches correspond in number to the translated groups and sub-groups which they represent; that is, the primary switch S^7 has twenty contacts s^{17} which are connected consecutively by conductors 13 to the twenty primary register-contacts s^{15} , and the secondary switch S^8 is provided with five fixed contacts s^{18} similarly connected by conductors 12^a with the conductors 12 which multiple the secondary register-contacts s^{10} into successive groups of five each. In connection with each of the switches S^7 and S^8 is shown an off-normal contact device s^{19} , of the same character as that of the switch S^5 each being associated with two relays R^7 and R^{77} and R^8 and R^{88} , respectively.

From the sending apparatus of the translator and from the tens and units sections of the starter main conductors L and L^2 and a disconnecting or release-conductor L^3 lead to the selecting apparatus C. As here illustrated, these conductors pass through a connecting key K^{11} organized to associate the transmitting portion of the system, both in the starter and translator, with any one of a plurality of selectors, as might be the case in practice. Though this key K^{11} has, in the diagrammatic illustration, the appearance of being situated at a considerable distance from the starter, it would in actual use be in such proximity to the starting-keys that all could be readily manipulated by a single operator. The selecting apparatus C in the present instance comprises a primary section C^2 , a secondary section C^3 and a final or connecting section C^4 ; these respectively correspond to the primary and secondary translated grouping and the original tens and units groups. An appropriate arrangement of selecting apparatus would consist of one primary selector for each starter and translator, this being connected

with a plurality of selectors, which in turn would be joined to the final selectors, the number of the secondary and final apparatus depending upon the grouping of the fixed terminals and upon traffic conditions. Selectors adapted for this purpose are well known, and there has been here shown in each section a switch similar in form and mode of operation to those of the starter and translator. They, therefore, need not particularly be described. Each of these primary, secondary and final switches designated as S^9 , S^{10} and S^{11} , respectively, and of which but one each is here illustrated, includes a shaft s^{20} carrying insulated main contact-arms s^{21} and s^{22} and a test contact-arm s^{23} . Ratchet mechanism serves to propel and retain the shafts this being operated by motor-magnets M^9 , M^{10} and M^{11} , and holding-magnets m^9 , m^{10} , and m^{11} . An off-normal contact device s^{24} is controlled by each switch, that of the switch S^9 having a double make and break, while the other two are single. The arms s^{21} , s^{22} and s^{23} operate over fixed contacts or terminals s^{25} . From these terminals in the primary section, conductors 62, 69 and 78 lead to the proper selector in the secondary section. For the concrete case we have taken, each set of terminals of the switch S^9 would correspond to one of the new or non-decimal groups of five hundred, and those of the switch S^{10} to some one of the hundreds of said group. The terminals of the secondary section are connected by conductors 81, 88 and 104 to selectors in the final section, the terminals of which are joined by conductors 16 to the instruments with which connection is to be made. Associated with the switches S^9 , S^{10} and S^{11} are relays R^9 , R^{10} and R^{11} , respectively; while the holding-magnets m^9 , m^{10} and m^{11} also operate as relays by means of contact-controlling springs r^9 , r^{10} and r^{11} movable with their armatures.

In circuit with the contact of the connecting key with which is associated the disconnecting conductor L^3 , and with the holding-magnet m^9 of the primary selector, is a normally-closed disconnecting or releasing-key K^{12} .

The circuits forming a part of the system will now be traced, and reference made to certain minor members not previously described, the connecting elements of the system, other than those joining the main groups of apparatus and certain internal conductors which are of especial importance, having to avoid confusion been omitted. At the same time a detailed statement of the operation of the entire organization will be given. For the latter purpose it may be assumed that the translating system is a portion of the equipment of a central station in a telephone exchange, the keys of the starter being under the control of an oper-

ator, and the lines 16 leading to substations which are to be connected with other substations through apparatus not shown, since it forms no part of this invention and may be of any convenient type. Let it be supposed, for example, that the subscriber's number communicated to the operator is, as usual, upon the decimal system and is 1211. It will be seen that while the thousands digit falls within the first decimal group and the hundreds digit in the second decimal group, the previously indicated rearrangement into primary groups of five hundreds rather than thousands will destroy such relation. Instead, considering the hundreds, which must now be taken since the primary group is less than one thousand, 1200 comes in the third of said primary groups, which three would aggregate 1500; then, as the number selected is greater than 1200, its hundreds belong to the third secondary group in the third primary group. The tens and units remain upon the original decimal basis, therefore the function of this particular system is to translate the impulses transmitted through the keys K in groups of tenths of ten thousand and tenths of thousands into groups of twentieths of ten thousand and fifths of the resulting five hundreds.

Upon receiving the number 1211 of the called subscriber, the operator closes the connecting key K^{11} and successively depresses the keys K^1 , K^2 and K^1 and K^1 of the sections A^2 , A^3 , A^4 and A^5 , respectively, of the starter A. These keys are held in their depressed position by the bars k . The thousands key grounds the corresponding terminal s^3 through a conductor 11 and a conductor 17 common to all the thousands keys, and also operates the holding-magnets m^2 and m^6 of the starting section A^2 and the translating-register by current from battery b^2 over conductors 18, 19, 20 and 17, and from battery b^6 over conductors 19, 20 and 17 to ground. The energization of the magnet m^2 closes a circuit from ground through conductor 22, contact and armature r^2 of the magnet m^2 , conductor 23, back contact and armature 24 of relay R^2 , conductor 25, winding of the thousands starter motor-magnet M^2 , conductor 26, winding of the primary motor-magnet M^6 of the register and conductor 27 to the interrupter I^6 and battery b^{66} . The closing of this circuit will cause the contact-arms of the thousands section of the starter and the register to be driven forward simultaneously by the ratchet mechanism. Each impulse which passes through the magnet M^2 advances the arm of the switch S^2 from one fixed contact to the next; while each impulse through the magnet M^6 of the register causes its arms s^{13} and s^{14} to move over two of the contacts s^{15} and ten of the contacts s^{16} . The arrival

of the thousands arm s^2 on the contact grounded by the key K^1 operates the relay R^2 over a circuit including the battery b^2 , conductors 28 and 29, arm s^2 of the switch S^2 and conductors 11 and 17 to ground, thereby opening the contact of its armature 24 and breaking the circuit of the motor-magnets M^2 , M^6 . This stops the advance of the switches S^2 and S^6 .

The operation of the armature 30 of the relay R^2 closes a circuit from ground through the contacts of the depressed hundreds key K^2 and including conductors 22, 31, 32 and 33 and the winding of the hundreds holding-magnet m^3 to the battery b^3 . The consequent energization of the magnet m^3 completes a circuit from ground through conductor 34, the armature contact r^3 , conductor 35, back contact and armature 36 of the relay R^3 , conductor 37, winding of the hundreds motor-magnet M^3 , conductor 38, winding of the secondary motor-magnet M^{66} of the register, conductors 39 and 27 to the interrupter I^6 and battery b^{66} ; and the completion of this circuit will result in the arms of the switches S^3 and S^6 being driven forward simultaneously. Each impulse passing through the motor-magnet M^3 moves the arm of the hundreds switch S^3 from one contact to the next, and likewise each impulse passing through the secondary motor-magnet M^{66} of the register drives its arms from contact to contact s^{16} . The operation of the relay R^2 in conjunction with the depressed hundreds key K^2 in section A^3 , in addition to closing the circuit of the motor-magnets just mentioned, has also established a ground at the third contact of the hundreds switch S^3 through the conductor 22, armature contact 30 and conductors 31, 32 and 40. The arrival of the hundreds contact-arm on this grounded contact operates relay R^3 from the battery b^3 through conductors 41 and 42 and the path just indicated to ground, thereby opening the back contact of its armature 36, and breaking the circuit of the hundreds motor-magnet M^3 of the starter and the secondary motor-magnet M^{66} of the translating register. The movement of the switches S^3 and S^6 therefore ceases. The depression of the thousands key K^1 has caused one impulse to pass through the primary motor-magnet of the register. The depression of the hundreds key K^2 sent two impulses through the secondary motor-magnet of the register. Therefore, since each impulse through the primary motor-magnet drives the register over two contacts s^{15} at a time, while each impulse of the secondary motor-magnet advances the arms over one contact s^{16} at a time, the arm s^{13} of the register will have come to rest on the third contact s^{15} , while the arm s^{14} will be upon the thirteenth contact s^{16} , which corresponds to the particular hundred, 12, contained in the desired number.

ber, since the first sub-group is the zero group, it embracing the units from 0 to 99. A ground connection is made with the register arms by a conductor 43, so that the arm s^{13} grounds the third contact s^{17} of the primary sender-switch S^7 through one of the conductors 13, while the arm s^{14} grounds the third contact s^{18} of the secondary sender-switch S^8 through the multiple conductor 12 and the conductor 12^a . As has been pointed out, it is in both the third group and sub-group of translated numbers that the hundreds of 1211 belong.

When the connecting-key K^{11} was operated, its contact $43'$ closed the circuit of the primary selector holding-magnet m^9 from ground through conductors 44 and 45 to battery b^9 energizing said magnet. The operation of the relay R^8 , in addition to opening the contact of its armature 36, closed a circuit from ground through the conductor 34, the contact of its armature $44'$, conductor 45^a , and the winding of the primary holding-magnet m^7 to battery b^7 . The energization of this holding-magnet closes a circuit from ground through the winding of the primary selector motor-magnet M^9 , conductor 46, back contact and armature 47 of the relay R^9 , contact 48 of the connecting-key, conductors L and 49, contact and armature 50 of the primary holding-magnet m^7 , back contact and armature 51 of the relay R^7 , conductor 52 and winding of the primary motor-magnet M^7 to the interrupter I^7 and battery b^{77} . The arm of the switch S^7 and arms of the switch S^9 will now be driven forward simultaneously. When the arm of the former arrives at the contact s^{17} connected to the third contact s^{15} of the register B a circuit is closed from ground through conductor 43, the arm s^{13} , conductor 13, arm of switch S^7 , conductor 53 and winding of relay R^7 to the battery b^7 . The energization of this relay opens the contact of its armature 51 and breaks the circuit of the motor-magnets of the primary sender and primary selector. It will be evident that the operation of the switch S^7 has allowed but three impulses to pass through the primary selector motor-magnet, so that the arms of the primary selector will have been brought to rest on the contacts corresponding to the third primary translated group of numbers. The arrival of the arm of the switch S^7 on the grounded contact, in addition to closing a circuit from ground to the battery b^7 through the winding of the relay R^7 , also completed a circuit from ground through the arm of the switch S^7 , off-normal contact s^{10} of the switch S^7 , conductor 54, back contact and armature 55 of the relay R^{77} , conductors 56 and L^2 , contact 57 of the connecting-key K^{11} , conductor 58, back contact and spring 59 of relay R^9 , the winding of said relay, conductor 60, off-normal contact s^{24} of the

primary selector and contact and spring r^9 to the battery b^{99} . The resulting operation of the relay R^9 of the primary selector disconnects its winding from the conductor L^2 and connects it to ground in series with the winding of the secondary selector holding-magnet m^{10} , through the conductor 61, holding-magnet m^{10} , conductor 62, arm s^{23} of the switch S^9 , armature 63 of relay R^9 , winding of said relay, conductor 60, off-normal contact s^{24} of the primary selector and contact r^9 to battery b^{99} .

The previous operations have brought the arms of the primary selector upon the fixed contacts corresponding to the third translated primary group. The next step is to advance the arms of the secondary selector representing the third primary group to its contacts corresponding to the third translated secondary group. The operation of the relay R^7 has closed a circuit from ground through its armature and front stop 64, conductor 65, the winding of the relay R^{77} , conductor 66, and winding of the holding-magnet m^8 of the secondary sender to battery b^8 . The actuation of the relay R^{77} disconnects at its armature 55 the conductor L^2 from the ground established by the off-normal contact and arm of the switch S^7 , and closes a circuit from ground through the winding of the secondary selector motor-magnet M^{10} , conductor 67, back contact and armature 68 of the relay R^{10} , conductor 69, arm s^{21} of the primary selector, front contact and armature 47 of the relay R^9 , contact 48 of the connecting-key, conductors L and 70, armature and front contact 71 of the relay R^{77} , conductor 72, back contact and armature 73 of the relay R^8 , conductor 74, and winding of the motor-magnet M^8 to the interrupter I^8 and battery b^{88} . The contact arms of the switches S^8 and S^{10} of the sender and secondary selector will now be driven forward synchronously. When the arm of the switch S^8 reaches its third contact s^{18} , which is connected with the third contact s^{16} of the third multiplied group of the register, a circuit is completed from ground through the conductor 43, arm s^{14} , conductors 12 and 12^a , arm of switch S^8 and winding of relay R^8 to battery b^{88} . The operation of this relay R^8 opens the contact of its armature 73 and breaks the circuit of the motor-magnets of the secondary sender and the secondary selector. Three impulses have now passed through the secondary selector motor-magnet M^{10} , so that the arms of its switch S^{10} come to rest on the contacts corresponding to the third sub-group of the third primary group of numbers. In addition to the effects just noted, the arm of the switch S^8 has also closed a circuit from ground through the off-normal contact of the switch S^8 , conductor 75, back contact and armature 76 of the relay R^{88} , conductor L^2 , contact 57 of the

connecting-key K^{11} , front contact and armature 77 of the relay R^9 , arm s^{22} of the primary selector, conductor 78, resting contact and spring 79 of the relay R^{10} , winding of said relay, conductor 80, off-normal contact of the secondary selector, contact and spring r^{10} of the holding-magnet m^{10} to battery b^{10} . The consequent actuation of the relay R^{10} disconnects its winding from the conductor 78 and arm s^{22} of the primary selector, and connects it to ground in series with the final selector holding-magnet m^{11} through conductor 81, arm s^{23} of the secondary selector, armature 82 and spring 79 of the relay R^{10} , winding of said relay, conductor 80, off-normal contact of the secondary selector and contact and spring r^{10} of magnet m^{10} to battery b^{10} .

The selection by means of the translated impulses has now been accomplished and there only remains the advancing of the arms of the final selector which has been picked out by the secondary selector to its fixed contacts connected with the line numbered 1211. The operation of the relay R^8 has previously completed a circuit from ground through its front contact and armature 83, conductor 84, contacts of the depressed tens key K^1 of the section A^4 of the starter, conductor 84^a , winding of the holding-magnet m^4 , conductor 85, and winding of the relay R^{88} to battery b^{88} . The energization of the relay R^{88} disconnects at its armature 76 the conductor L^2 from the off-normal contact s^{19} of the switch S^8 , and closes a circuit from ground through the winding of the final selector motor-magnet M^{11} , conductor 86, back contact and armature 87 of the relay R^{11} , conductor 88, arm s^{21} of the secondary selector, front contact and armature 68 of the relay R^{10} , conductor 69, arm s^{21} of the primary selector, front contact and armature 47 of the relay R^9 , contact 48 of the connecting-key K^{11} , conductors L and 89, front contact and armature 90 of the relay R^{88} , conductor 91, back contact and armature 92 of the relay R^4 , conductor 93 and winding of the motor-magnet M^4 to the interrupter I^4 and battery b^4 . The closing of this circuit will advance the arm of the switch S^4 and the arms of the final selector simultaneously until the arm of said switch S^4 reaches the contact corresponding to the depressed tens key K^1 . Then a circuit is closed from the battery b^{44} , through the winding of the relay R^4 , arm of the switch S^4 , conductor 94, tens key K^1 , conductor 84, front contact and armature 83 of the relay R^8 to ground. The passage of current through this circuit actuates the relay R^4 , which in turn disconnects the motor-magnet M^4 of the tens starting-section from the conductor L at the armature 92, and completes a circuit from ground through conductor 95, the depressed units key K^1 of the section A^5 ,

conductor 96, front contact and armature 97 of the relay R^4 , conductor 98, and the winding of the holding-magnet m^5 of the units section to battery b^5 .

The operation of the magnet m^5 closes a circuit from the battery b^{55} through the interrupter I^5 , the winding of the motor-magnet M^5 , conductor 99, back contact and armature 100 of the relay R^5 , front contact and armature r^5 of the holding-magnet m^5 , conductor L , contact 48 of the connecting-key K^{11} , front contact and armature 47 of the relay R^9 , arm s^{21} of the primary selector, conductor 69, front contact and armature 68 of the relay R^{10} , arm s^{21} of the secondary selector, conductor 88, back contact and armature 87 of the relay R^{11} , conductor 86 and winding of the motor-magnet M^{11} of the final selector to ground. The arms of the final selector will now continue to move forward synchronously with the arm of the switch S^5 . When the arm of said switch arrives at its contact grounded by the units key K^1 , the relay R^5 is energized by current from battery b^{55} through the winding of said relay R^5 , conductor 101, arm of the switch S^5 , and conductors 102 and 95 to ground and breaks the circuits of the motor-magnets M^5 and M^{11} at the armature contact 100. On account of the space between the contacts s^3 in the tens starting section, ten steps are necessary to effect this, and therefore the final selector arms now rest upon the tenth set of active contacts. The arm of the switch S^5 also closes a circuit from ground through the off-normal contact s^{33} of the switch S^5 , conductor L^2 , contact 57 of the connecting key, front contact and armature 77 of the relay R^9 , arm s^{22} of the primary selector, conductor 78, front contact and armature 103 of the relay R^{10} , arm s^{22} of the secondary selector, conductor 104, contact and spring 105 of the relay R^{11} , winding of said relay, conductor 106, off-normal contact of the final selector and contact and spring r^{11} of the holding-magnet m^{11} of the final selector to battery b^{11} . The relay R^{11} disconnects its winding from the conductor L^2 and connects it to ground at the selected substation, the circuit being through the line conductor 16, arm s^{23} of the final selector, armature 107 and spring 105 of the relay R^{11} , winding of said relay, conductor 106, off-normal contact of the final selector and spring r^{11} of the magnet m^{11} to the battery b^{11} . The front contacts of the armatures 87 and 108 of the relay R^{11} close the circuits from the selected points through conductors 88 and 104, the secondary and primary selectors and connecting-key K^{11} completing the operation.

The relay R^5 when energized closed a circuit from ground through its armature 109, conductor 110, contact and spring 111 of the disconnecting relay R^{55} , winding of said re-

lay, the lamp 1, conductor L^3 , the contact 43 of the connecting key to battery b^9 . The relay R^{55} upon actuation locks itself by a circuit from ground through its armature 112, spring 111 and its winding to the battery b^9 as just described. The lamp 1 in series with the relay R^{55} is illuminated, notifying the operator that the starting apparatus has completed its operation. The relay R^{55} also attracts its armature 113 sending a momentary impulse from battery b^{55*} through said armature, spring 114, and conductors 115 to the magnets k^2 of all the sets of transmitting keys K of the starter, thus releasing them. The opening of the starting circuits in turn releases the holding-magnets m^2 , m^3 , m^4 and m^5 , allowing the springs of the switches to act and restoring the starter to its normal condition.

The operator upon observing the lighting of the lamp 1 may throw the connecting key K^{11} , which will put out the lamp and release the relay R^{55} . The selecting apparatus will, however, be held against release by current through the holding-magnet m^9 of its primary section; this passing from the positive pole of the battery b^{99} through the winding of the magnet m^9 , conductor 45, disconnecting-key K^{12} , conductor 116, second spring 117 of the off-normal contact of the switch S^9 and spring r^9 of the holding-magnet m^9 back to the negative pole of the battery. When the path through the selecting apparatus to the selected terminals is no longer required the selectors may be released by opening this auxiliary holding-circuit at the disconnecting-key, whereupon the holding-magnets of the selectors successively withdraw their pawls and the switches S^9 , S^{10} and S^{11} are returned to zero by their springs.

To summarize the operation of the system, it may be said that the depression of the keys of the starter representing the digits of the numeral designating the line to be selected establishes a series of impulses grouped in accordance with whatever original system may be employed, usually the decimal. All these impulses ultimately affect the selecting apparatus, but those groups which are to act in accordance with new grouping are received by the register of the translator. This register, by the number, relative length of contact surface and manner of connection of its contact members causes impulses to pass from the sender in a translated or regrouped condition to the proper sections of the selecting apparatus, terminals of which are disposed in accordance with the new grouping. In this selecting apparatus both the translated and untranslated impulses operate to successively advance the contact arms to the desired terminals, the final section securing connection with those corresponding to the

number represented by the starting-keys which have been depressed. After the starter and translator have impressed all the impulses upon the selector their movable elements are restored to their initial position, and when the use of the connected lines is completed the movable members of the selector are also returned to their normal places.

From what has been said it is believed that the great gain in flexibility of a connecting system through the translation of its numerical grouping will be obvious, but it is desired to particularly note, as exemplifying the extent to which advantages accrue, that by proper rearrangement of the terminals of the translator and the selecting apparatus the secondary section of the latter may be entirely eliminated, leaving only the primary and final sections. The economy of this will be manifest.

Having thus described my invention, I claim:

1. A translating system comprising means for transmitting electrical impulses in a predetermined group or groups, and mechanical means for receiving and again transmitting impulses in a definite number of groups having a different relation from those originally transmitted.
2. The combination with apparatus for effecting the selection of electrical terminals, of means for transmitting groups of electrical impulses, and means for receiving and translating the impulses into different groups which pass to the selecting apparatus, substantially as hereinbefore set forth.
3. The combination with means for transmitting predetermined groups of electrical impulses, of selecting apparatus comprising a section provided with terminals arranged in accordance with said groups and another section having terminals arranged upon another system of grouping, and means between the transmitting means and selecting apparatus for translating a portion of the impulses sent out by the former in accordance with the new grouping of the selecting apparatus.
4. In a telephone system, the combination with means for transmitting predetermined groups of electrical impulses, of selecting apparatus comprising a section provided with line-terminals designated by numbers having the same numerical relation as the groups of impulses and a section having terminals arranged upon another grouping, and means between the transmitting and selecting apparatus for translating a portion of the impulses sent out by the transmitting means in accordance with the new grouping of the selecting apparatus, substantially as and for the purpose set forth.
5. An apparatus for translating electrical conditions comprising a series of register-

contacts, a series of sending-contacts connected therewith, a movable contact member cooperating with each series of contacts, and motor mechanism for advancing the movable members.

6. An apparatus for translating electrical conditions comprising a primary series of contacts, a secondary series of contacts connected in multiple, a companion series of contacts corresponding to each of the primary and secondary series, connections between each contact of the primary series and each multiple group of contacts of the secondary series and a contact of its companion group, and a movable contact member cooperating with each series of contacts.

7. An apparatus for translating electrical conditions comprising a series of register-contacts, a series of sending-contacts successively connected with the register-contacts, a second series of register contacts multiplied together in groups, a corresponding series of sending-contacts connected with the multiple groups, a movable contact member cooperating with each set of contacts, and motor mechanism for advancing the movable members.

8. An apparatus for translating electrical conditions comprising a series of register-contacts, a series of sending-contacts successively connected with the register-contacts, a second series of register-contacts multiplied together in groups, each of said groups being equal in length of combined contact surface to one of the first-named contacts, a corresponding series of sending-contacts connected with the multiple groups, a movable contact member cooperating with each set of contacts, and motor-mechanism for advancing the movable members, substantially as specified.

9. An apparatus for translating electrical conditions comprising a series of register-contacts, a series of sending-contacts successively connected with the register-contacts, a second series of register-contacts multiplied together in groups, each of said groups being equal in length of combined contact surface to one of the first-named contacts, a corresponding series of sending-contacts connected with the multiple groups, a movable contact member cooperating with each set of contacts, and a plurality of motor mechanisms for advancing the movable members.

10. The combination with a source of electrical impulses, of a starting-switch, and an impulse-translator comprising a switch provided with register contacts and with motor mechanism in circuit with the starting-switch, and a sending-switch having motor mechanism also in circuit with the starting-switch and provided with contacts connected with the register-contacts.

11. The combination with a source of elec-

trical impulses, of a plurality of starting switches operable successively, an impulse translator comprising a switch provided with a plurality of register contacts and with motor mechanism in circuit with one or more of the starting switches, and a sending apparatus having switch sections corresponding to one or more of the starting switches and provided with motor mechanism in circuit with said starting switches, each of the sending switches having a series of contacts connected with one of the series of register contacts, substantially as described.

12. The combination with a plurality of starting-switches having motor mechanism and a series of contacts for controlling the motor mechanism, said series of contacts bearing some definite numerical relation to one another, of a translator comprising a switch provided with motor-mechanism controlled in the contacts of the starting-switches and a series of contacts corresponding to certain of the starting-switches but arranged in groups differing from those of said starting-switches.

13. The combination with a source of electrical impulses, of a starter comprising a plurality of switches each having motor mechanism and a series of contacts for controlling the motor mechanism, said series of contacts bearing some definite numerical relation to one another, an impulse-translator comprising a receiving-switch provided with motor mechanism controlled in the contacts of the starting-switches, and a series of register-contacts corresponding to certain of the starting-switches but arranged in groups differing from those of said starting-switches, and a sending-switch for each series of register-contacts, each of said sending-switches having motor mechanism in circuit with that of a receiving-switch and also having series of contacts to which the groups of register-contacts are connected, substantially as set forth.

14. The combination with a starting-switch, of a translator comprising a switch provided with motor mechanism controlled at the starting-switch and with register-contacts and a sending-switch having motor mechanism controlled at the starting-switch and also having contacts connected with the register-contacts, and a selecting apparatus provided with motor mechanism controlled in the contacts of the sending-switch.

15. The combination with a source of electrical impulses, of a starter comprising a plurality of switches operable successively, an impulse translator comprising a switch provided with a plurality of register contacts and with motor mechanism in circuit with one or more of the starting switches, and sending apparatus having switch sections corresponding to one or more of the

starting switches and provided with motor mechanism in circuit with said starting switches, each of the sending switches having a series of contacts connected with one of the series of register contacts, and a selector comprising switches provided with motor mechanisms, a portion of which are controlled in the contacts of the sending switches and a portion in the contacts of the starting switches, substantially as described.

16. An electrical translating apparatus comprising a switch having primary contacts corresponding to groups of units and secondary contacts connected in sets corresponding to the main groups, the members of each set corresponding to sub-groups of the main groups, and switches each provided with a series of contacts connected respectively to the primary contacts and sets of secondary contacts.

17. An apparatus for translating electrical conditions comprising starting means, a series of register contacts, a series of sending contacts connected therewith, and mechanically advanced contact members co-operating with the said register and sending contacts, the movement of certain of said contact members being controlled by the starting means.

18. In an apparatus for electrical selection, the combination of means for producing grouped electrical impulses, means operated in accordance with said impulses for establishing differently grouped impulses in accordance with a predetermined system, and selecting means operated in accordance with said last named impulses.

19. An electrical system for selecting terminals comprising an apparatus having starting members corresponding to groups of some numerical system, and means controlled by the starting members for effecting selection of terminals in accordance with a numerical grouping different from that first named.

20. A translating system comprising means for transmitting electrical impulses in a predetermined group or groups, and means for receiving and again transmitting impulses in one or more predetermined regrouped conditions.

21. The combination with apparatus for effecting electrical selection, of starting means for establishing electrical conditions in accordance with some numerical grouping, and means controlled by the starting means for establishing other electrical conditions upon a different predetermined grouping for causing the selecting apparatus to operate.

22. In a telephone system, the combination with selecting apparatus, of controlling apparatus therefor which may be set manually, and means forming a part of the controlling apparatus for translating the con-

dition registered thereon into a different condition effecting selection.

23. A telephone system comprising a central station, electromechanical line selecting apparatus, apparatus situated at the central station and adapted to be set by an operator to control selection, and means for translating the electrical condition resulting from the setting into a different electrical condition whereby selection is effected.

24. A telephone exchange comprising a central station, substations designated in accordance with some definite system, telephone lines connecting the substations and central station, mechanical selecting apparatus to which said lines are connected, and means for effecting line selection in accordance with some different system than that by which the lines are designated.

25. Controlling apparatus for electrical line selecting apparatus comprising manually operable registering devices including means adapted to govern the operation of secondary mechanism, secondary mechanism for registering the conditions produced at the manual devices, and transmitting means operable in accordance with such registration.

26. A controlling apparatus for telephone line selecting apparatus comprising key mechanism upon which a line designation may be registered, automatic registering mechanism operable in accordance with the line designation registered upon the key mechanism, and transmitting means operable in accordance with the registration of the automatic mechanism.

27. A controlling apparatus for telephone line selecting apparatus comprising key mechanism upon which a line designation may be registered to produce certain electrical conditions, automatic registering mechanism governed by the keys and being adapted to produce similar electrical conditions, and transmitting means operable in accordance with the registration of the automatic mechanism.

28. A controlling apparatus for telephone line selecting apparatus comprising key mechanism, primary transmitting mechanism controlled by the key-mechanism, registering mechanism governed by the primary transmitting mechanism, and secondary transmitting mechanism under the influence of the registering mechanism, substantially as described.

29. The combination with a starting switch, of key mechanism for determining the movement of the starting switch, a register switch movable with the starting switch, and a sending switch the travel of which is limited by the position of the register switch.

30. The combination with starting switches, of key mechanism for determining the movement of the starting switches, and

register switch provided with a plurality of motor mechanisms any one of which may be connected with the starting switches, and a sending switch governed by the register switch.

31. A controlling apparatus for telephone line selecting systems comprising manually operable means for registering line designations, automatic registering means operable under the influence of said manual means to establish and register electrical conditions, and selection controlling means automatically governed by said automatic registering means in accordance with the electrical conditions established thereat.

32. A controlling apparatus for telephone line selecting systems comprising manually operable contact devices, an electromechanism having terminals connected to said manual contact devices and having a contact member movable over said terminals, and an electromechanism provided with terminals, the condition of which is determined by the position of the movable member of the first-named electromechanism and itself having a movable member governed by the condition of its terminals and serving to control selection.

33. In a telephone switching system, the combination with line selecting apparatus, of controlling apparatus therefor, manually operable registering means corresponding to a particular system of line grouping, and an electromechanism operable under the influence of the manual means and arranged to control selection in accordance with some other system of line grouping.

34. In a telephone switching system, the combination with line selecting apparatus, of controlling apparatus therefor, manually operable registering means corresponding in grouping to a particular system of line grouping, and an electromechanism provided with a contact member movable to a point determined by the manual means, and cooperating selection controlling contact members arranged in accordance with some other system of line grouping.

35. In a telephone switching system, the combination with line selecting apparatus, of controlling apparatus comprising contact means representing a certain number of components of a line designation, and means whereby the actuation of said contact means causes a different number of selective operations.

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

first named and provided with terminals grouped differently therefrom and provided with a cooperating movable contact member through which the controlling function of the apparatus is exercised.

37. A controlling apparatus comprising a series of manually operable contact devices having a definite grouping, an electromechanism having terminals corresponding to the grouping of the manual devices and connected to said devices and a movable member contacting with said terminals, a second electromechanism connected to that first named and provided with terminals grouped differently therefrom and with a cooperating movable contact member, and means for causing the movable member of said first named electromechanism to vary the condition of said second electromechanism and to thus determine the travel of its movable member.

38. Controlling apparatus for electrical line selecting systems comprising line designating devices, secondary mechanism adapted to establish and register operative conditions produced at said devices, and selection controlling means automatically governed by said established conditions.

39. In apparatus for effecting selection of electric terminals, the combination of means for initiating terminal selection in accordance with some predetermined system, and means controlled by said first-named means for continuing selection in accordance with a different predetermined system.

40. In apparatus for selecting numerically designated electric terminals, the combination of means for initiating terminal selection in accordance with a predetermined system, means continuing selection on a different predetermined system, and terminal selecting means controlled by said last named means.

41. In an automatic circuit controlling apparatus, the combination with a plurality of sets of manually operable contact devices, of automatic means for separately registering the conditions produced at said sets of contact devices respectively by the establishment of electrical conditions and selection controlling means automatically governed by the electrical conditions produced at the automatic registering means.

42. A circuit controlling apparatus comprising manually operable means having register elements grouped according to a particular system, automatically movable registering means adapted to assume a position determined by the registration of the manual means, and selection controlling means governed by said automatic register means and having controlling elements grouped upon a different system from those of the manual registering means.

43. In an electrical line selecting system, the combination of manually operable registering devices; automatic registering means for establishing conditions under the control of said manual devices; and line selecting means automatically governed in operation by the conditions established by said automatic registering means.

44. In an electrical line selecting system, the combination of manually operable contact devices; automatic contact mechanism for registering conditions produced at the manually operable devices; and line selecting means automatically governed in operation by the conditions registered at said automatic contact mechanism.

45. In an electrical line selecting system, the combination of a set of keys; an automatic register switch movable under control of the keys to a position determined by an operated key; and line selecting means auto-

matically governed in operation by the position of said register switch.

46. In a telephone exchange system, the combination with electrical apparatus adapted to determine a telephone line to be selected, of starting means for establishing electrical conditions in accordance with some numerical grouping, and means controlled by said starting means for establishing other electrical conditions upon a different predetermined grouping and thereby causing said electrical apparatus to operate to determine a telephone line to be selected.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this eighteenth day of April 1906.

EDWARD C. MOLINA.

Witnesses:

GEO. WILLIS PIERCE,
JOSEPH A. GATELY.