

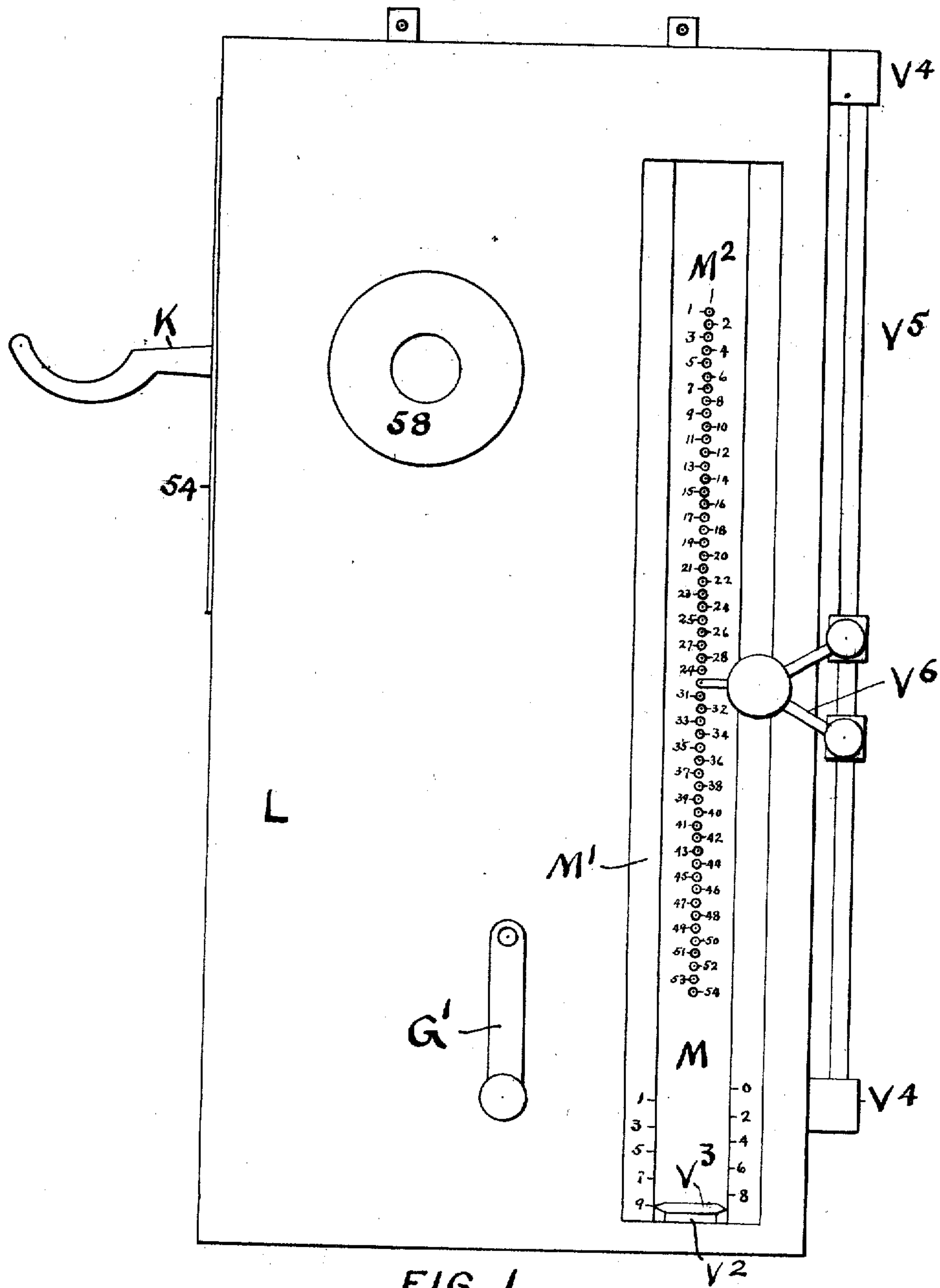
No. 829,419.

PATENTED AUG. 28, 1906.

N. E. NORSTROM.
TELEPHONE EXCHANGE.

APPLICATION FILED NOV. 14, 1903.

7 SHEETS—SHEET 1.



WITNESSES
Howard A. Reafield
Clarence E. Store.

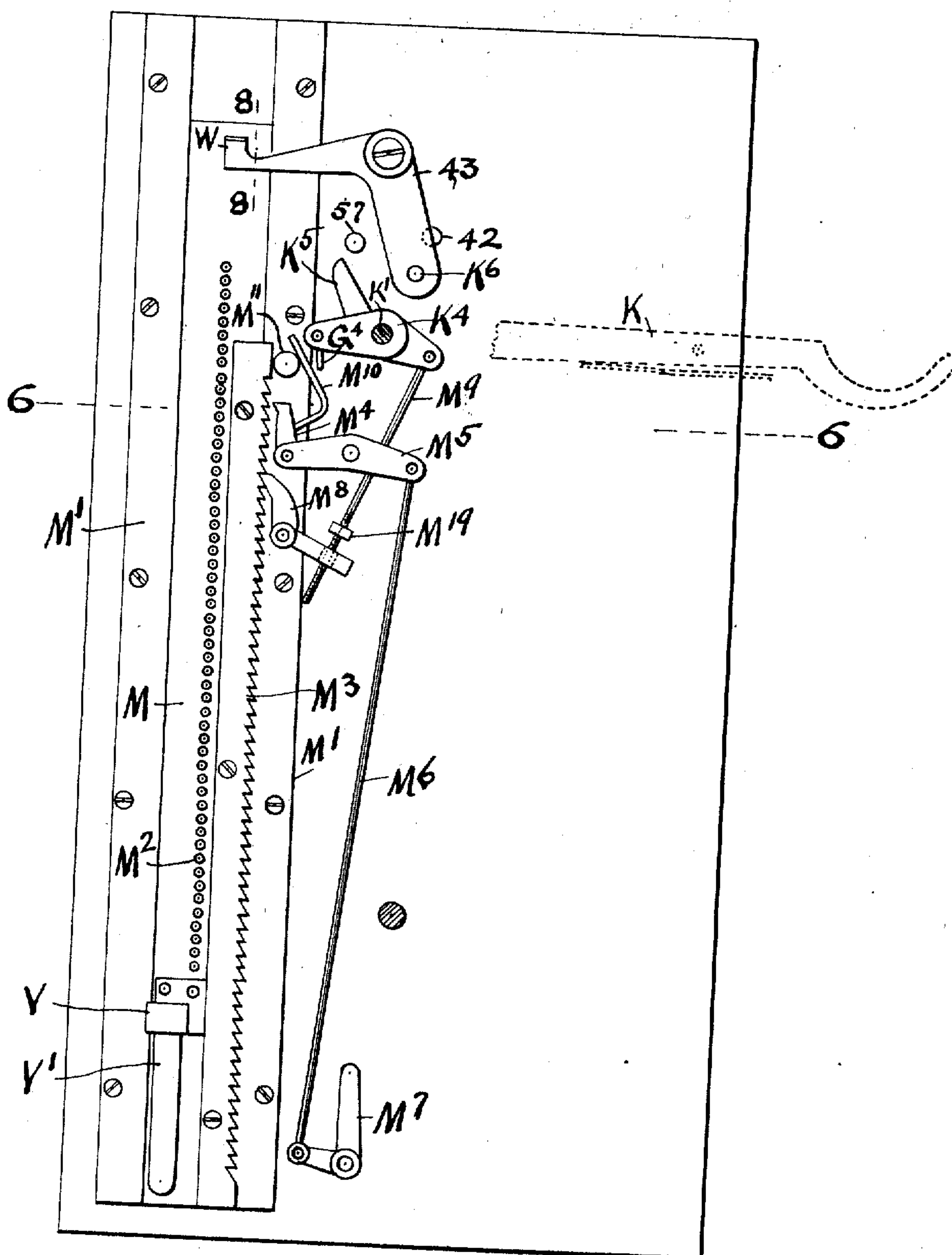
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7 SHEETS—SHEET 3.



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FIG. 3.

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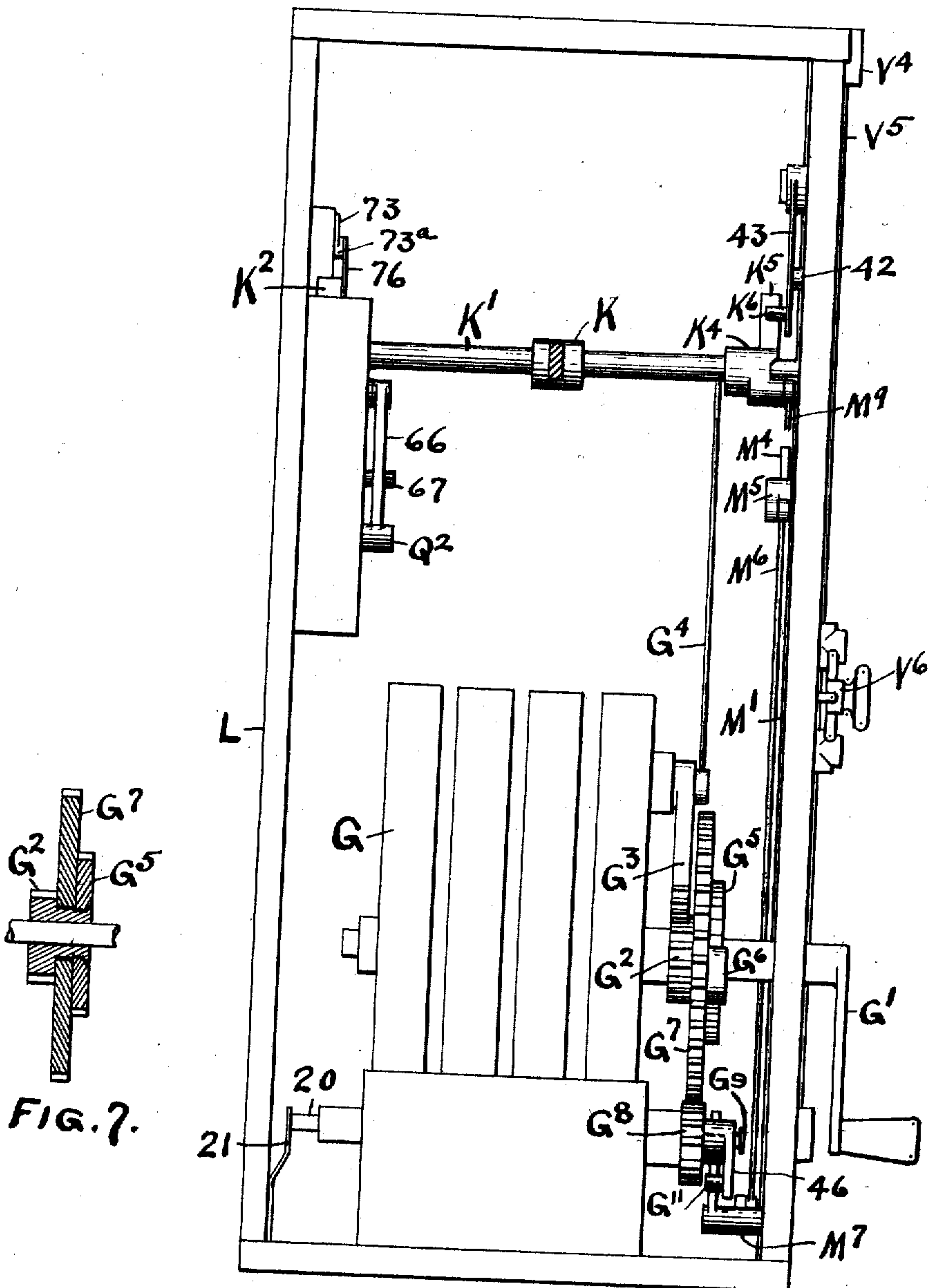


FIG. 7.

W
43
FIG. 8.

FIG. 4.

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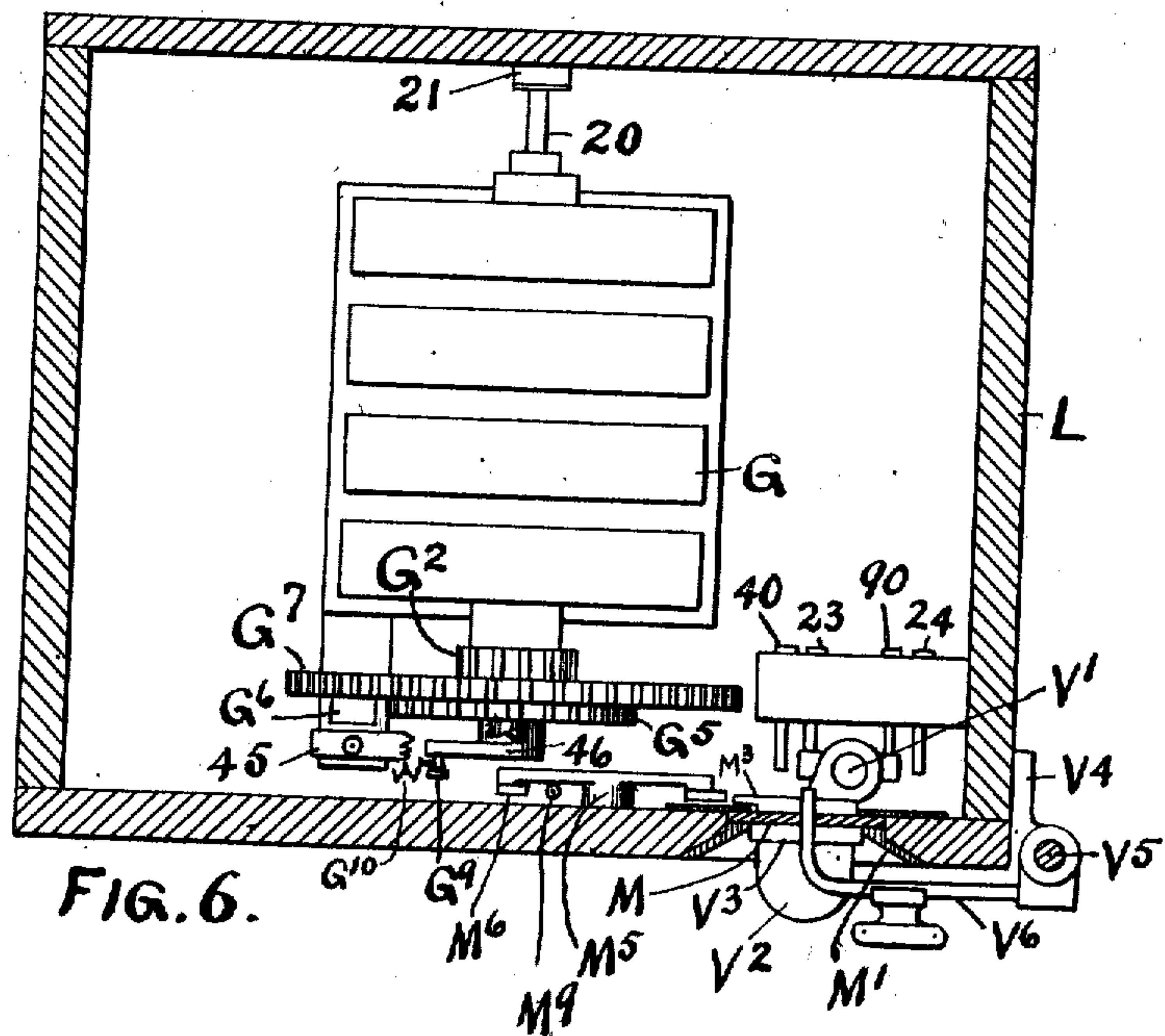
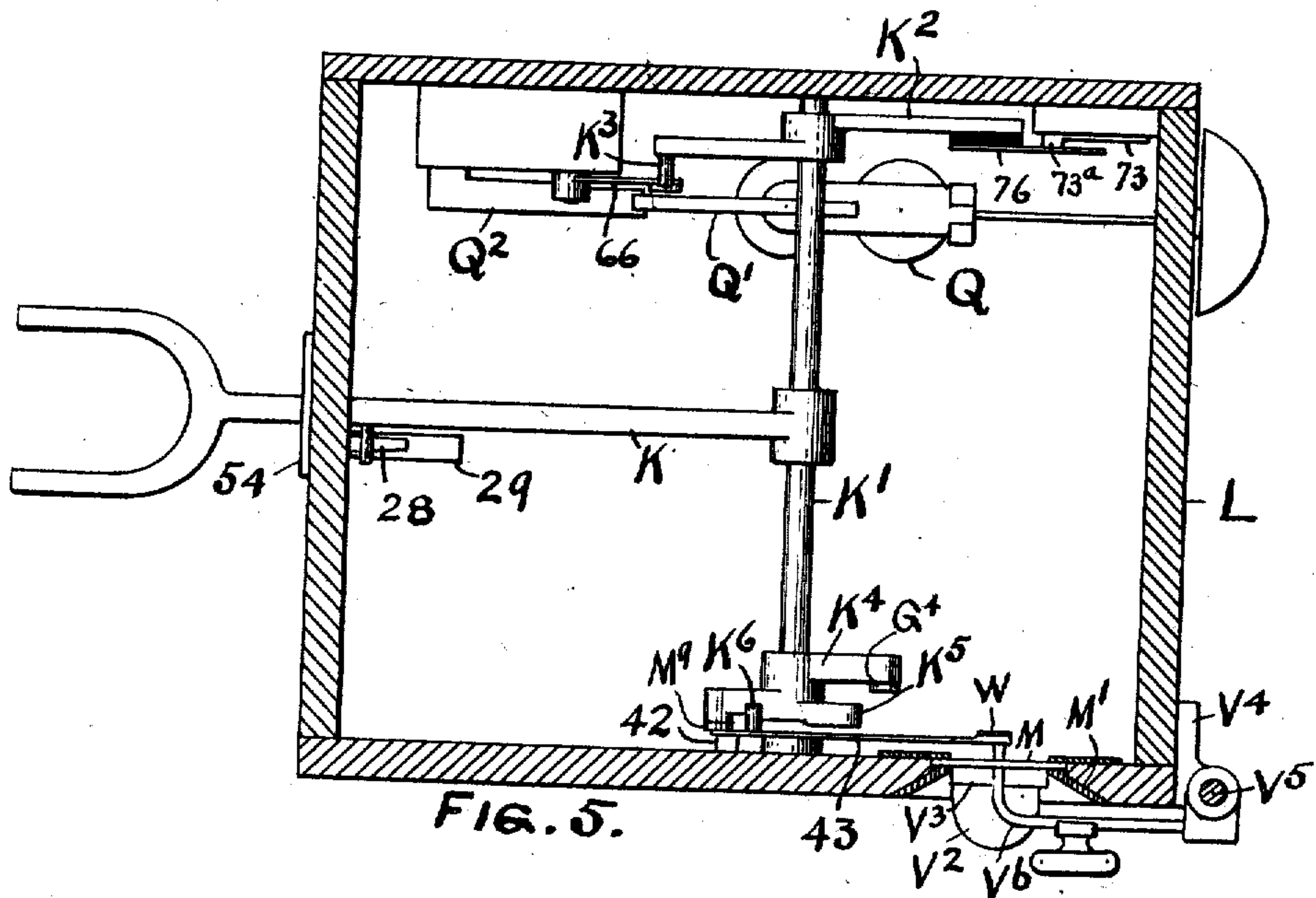
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7 SHEETS—SHEET 5.



WITNESSES

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INVENTOR

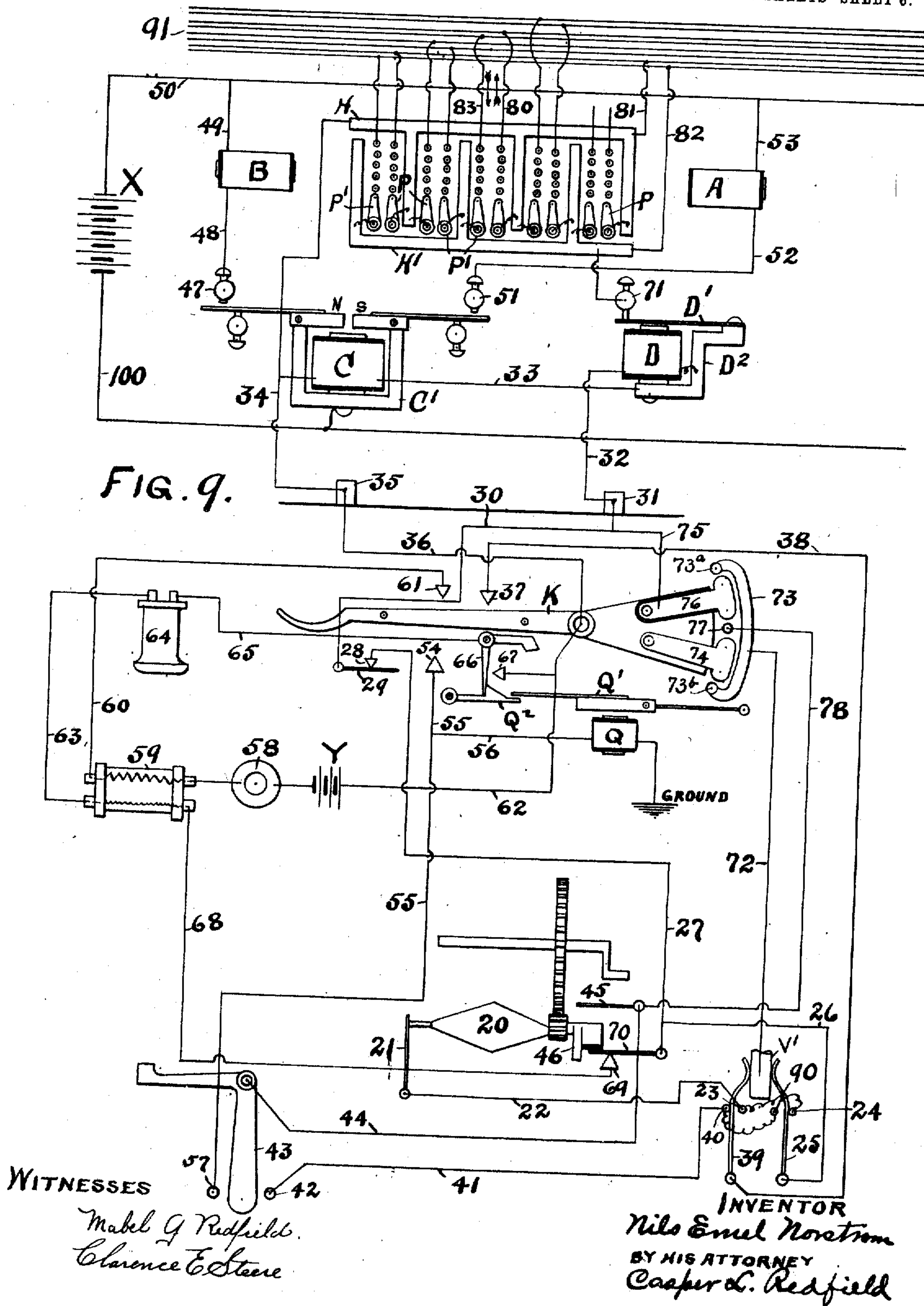
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7 SHEETS—SHEET 6.



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7 SHEETS—SHEET 7.

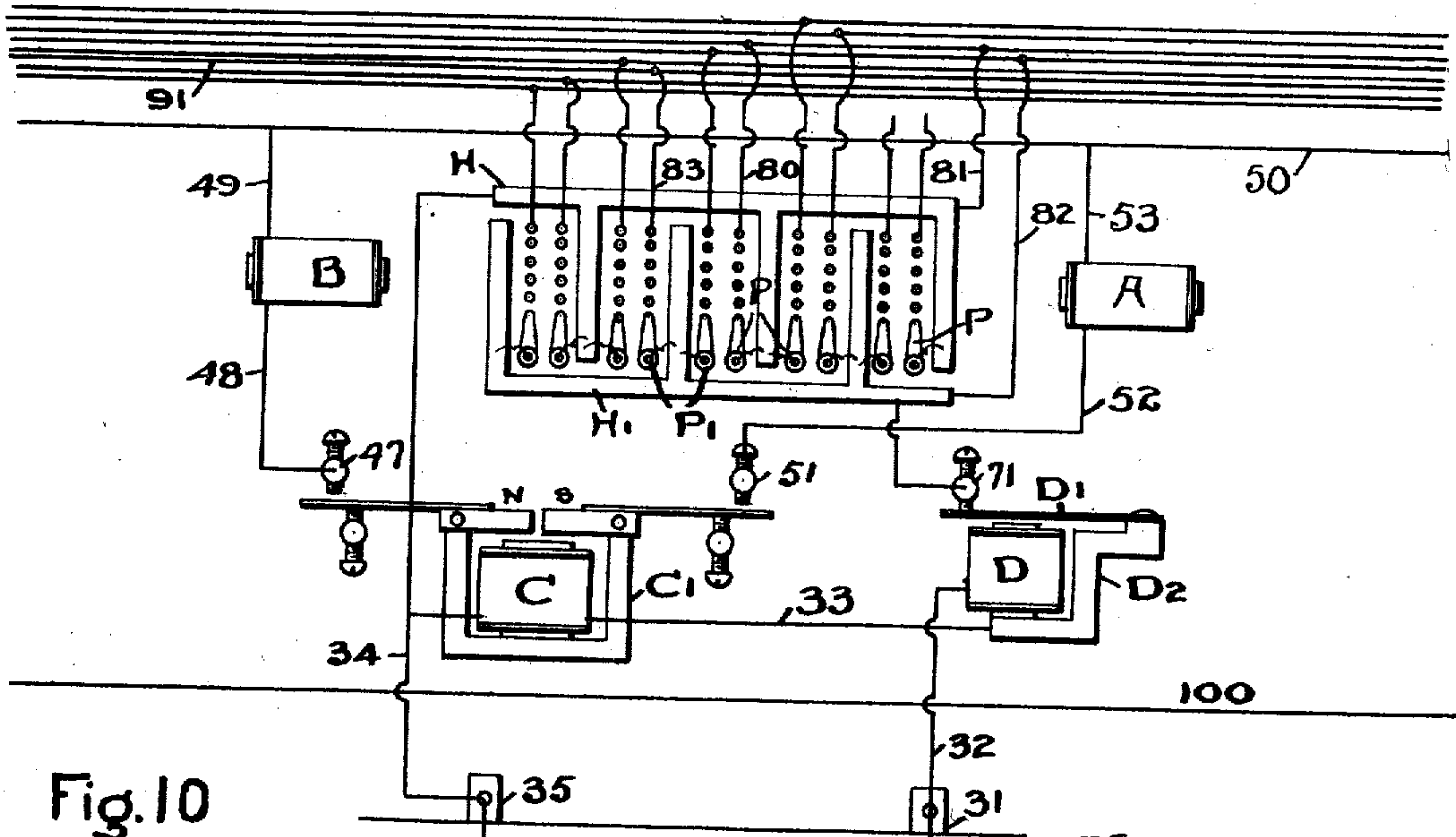
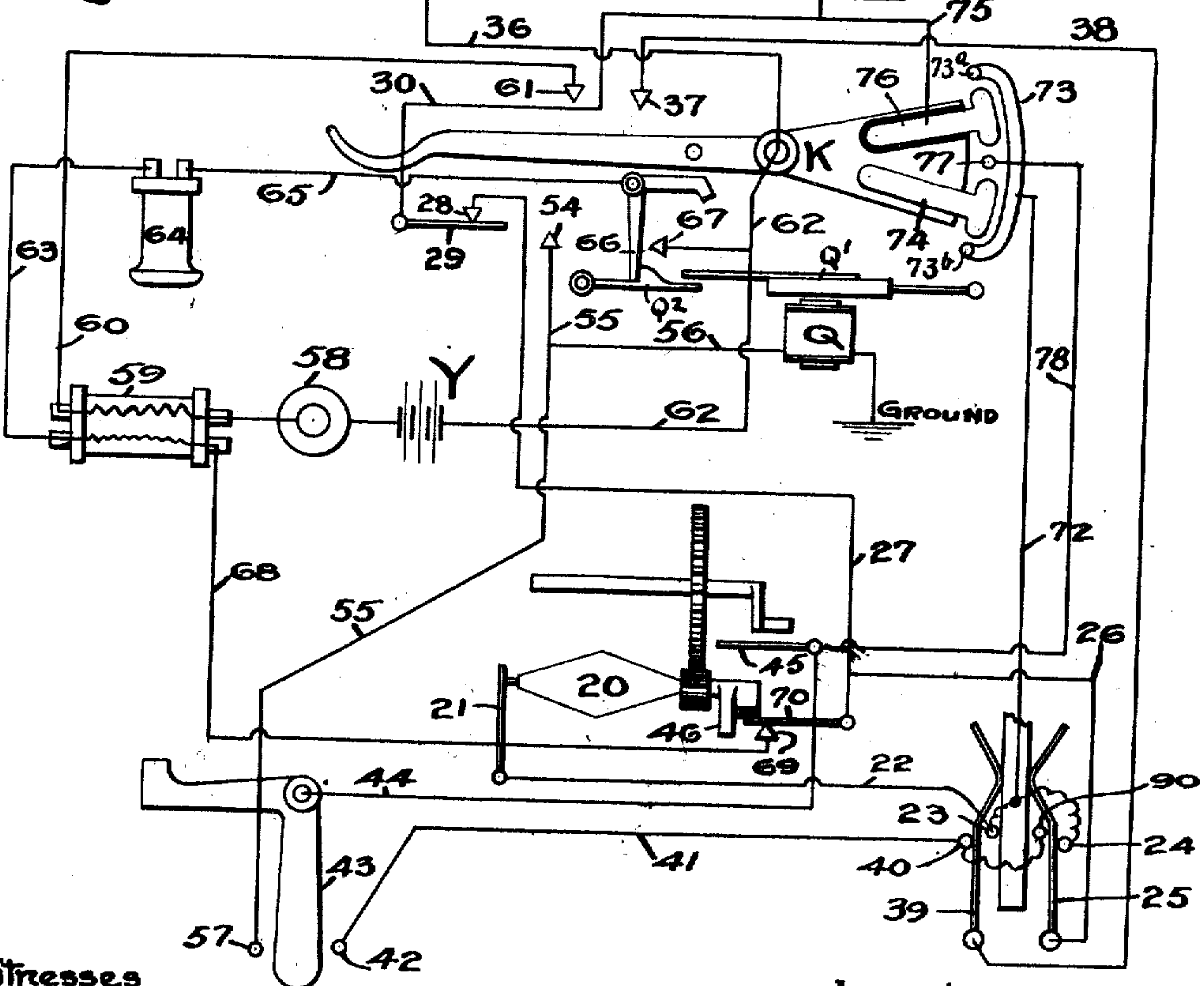


Fig. 10



Witnesses

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UNITED STATES PATENT OFFICE.

NILS EMEL NORSTROM, OF CHICAGO, ILLINOIS, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, OF ONE-HALF TO JOHN ANDERSON, OF SALINA, KANSAS, AND ONE-SIXTH TO GLOBE AUTOMATIC TELEPHONE COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE-EXCHANGE.

No. 829,419

Specification of Letters Patent.

Patented Aug. 28, 1906.

Original application filed May 31, 1900, Serial No. 18,519. Divided and this application filed December 14, 1903. Serial No. 181,133.

To all whom it may concern:

Be it known that I, NILS EMEL NORSTROM, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone-Exchanges, of which the following is a specification.

My invention relates to telephone-exchanges, and more particularly to the call mechanism by which a required station is selected, the present application being a division of my pending application, Serial No. 18,519, filed May 31, 1900.

The object of my invention is to simplify the manual operations and provide mechanism which will insure the proper selection.

In carrying out my invention I arrange at each telephone-station an index or keyboard, which is set at the required selection, after which the total operation is performed by the subscriber turning a crank. The selection itself is done automatically. By having a keyboard or index which is set if there is any error in the proper selection the keyboard will indicate whether the fault lies with the subscriber or the apparatus.

In the accompanying drawings, Figure 1 is a front elevation of one of the telephone-boxes used at the local stations. Fig. 2 is a similar view with the front cover of the box removed. Fig. 3 is an inside view of the cover, showing the parts attached thereto and some of the parts that also appear in Fig. 2. Fig. 4 is a side elevation of the box with a side removed so that the interior mechanism may be shown. Fig. 5 is a horizontal section across the upper part of the telephone-box, showing some of the upper interior mechanism. Fig. 6 is a similar section on line 6 6 of Fig. 3 showing some of the parts in the lower part of the box. Fig. 7 is a detail in section of some of the gears shown in Figs. 2 and 6. Fig. 8 is a section on line 8 8 of Fig. 3; and Figs. 9 and 10 are diagrams showing the apparatus at two telephone-stations and their connections to corresponding switching mechanisms at the central office.

On the front cover of the telephone-box L is arranged a slide M, which is vertically movable in guides M'. In the said slide are a series of small holes M², which are numbered consecutively from "1" to any required number, according to the length of the slide M, which length is determined by the number of

holes required. On the lower front portion of the slide M is a projection V², by which the vertical position of the slide M may be adjusted by hand. Adjacent to the projection or lug V² is a pointer V³, and on the front face of the outer guides M' are a series of graduations marked from "0" to "9," as illustrated in the lower right-hand portion of Fig. 1. At its lowest or normal position the pointer or indicator V³ points at the graduation marked "9." Inside of the telephone-box is the ordinary generator G, which may be rotated in the ordinary manner by crank G' on the front of the telephone-box. On the crank-shaft of the said generator is a small gear G², which is engaged by a segment of a larger gear G³, pivoted to a bracket on the generator G.

Secured on a hub of the gear G² is a ratchet-wheel G⁵, and loosely supported on said hub between the gear G² and ratchet G⁵ is a large gear G⁷, which engages a gear G⁸ on the armature of said generator. Pivoted on the gear G⁷ is a pawl G⁶, arranged to engage with the ratchet G⁵, so that when said ratchet is turned in one direction said turning will cause a rotation of the gear G⁷, and consequently of the armature of the generator. When, however, the crank is turned in an opposite direction, the ratchet-wheel G⁵ will pass under the pawl G⁶, and as a consequence the armature of the generator will not be rotated. On the armature-shaft is a segment of a disk 46, on which there is a pin G⁹, to which is connected a spring G¹⁰, tending to hold the armature of said generator in a given position. When the crank G' is rotated clockwise, the ratchet-wheel G⁵ drives the gear G⁷, which in turn drives the gear G⁸, and consequently the armature of the generator. If, however, the speed of rotation is not sufficient to generate a current, the tension of the spring G¹⁰ will accelerate the movement of the armature during the last half of the rotation to a speed sufficient to cause a proper current to be generated. This acceleration is permitted by reason of the fact that when the crank is turned clockwise the ratchet-wheel G⁵ is driven as fast as the crank, but the gear G⁷ may move faster by the pawl G⁶ riding over the ratchet-wheel if the tension of the spring G¹⁰ is sufficient to cause it to do so. If, however, the rotation of the crank G' by hand is of speed sufficient to cause a proper generation of a current, the spring G¹⁰ does not act to accelerate the

speed of the armature. The spring G^{10} therefore acts to stop the armature at a given position when the crank is not being rotated and also as to produce a certain required speed of the armature of the generator at a certain required portion of its rotation.

Secured on the rear face of the disk 46 is an insulated pin G^{11} , which in its normal position engages a contact-spring 70 and pushes it into electrical connection with another spring 69. When, however, the armature is rotated, the pin G^{11} passes out of engagement with the spring 70 and permits it to break its electrical connection with the spring 69. Insulatingly secured to the generator-frame is a contact-spring 45, which is engaged by disk 46 at one portion of its rotation so as to make electrical connection between the two at that particular time, but to break such electrical connection at other portions of the rotation.

Pivoted on the front cover is a bell-crank lever M^7 , which is engaged by pin G^{11} at one portion of the rotation of the armature of the generator. This engagement causes a vibration of the bell-crank lever M^7 on its pivot. Secured at a suitable point on the cover of the telephone-box is a lever M^5 , which carries a pawl M^4 , adapted to engage a ratchet-bar M^3 , secured on slide M . The lever M^5 is connected by a rod M^6 to the bell-crank lever M^7 , so that when the lever M^7 is engaged by pin G^{11} the vibration of the lever M^7 will cause the same vibration of the lever M^5 , the result of which is to cause the pawl M^4 to engage the ratchet M^3 and move it upward one tooth. The pawl M^4 serves to hold said ratchet M^3 , and consequently the connected slide M , from a downward movement until the said pawl M^4 is released, as will hereinafter be described. On the pawl M^4 is a bent wire M^{10} , which engages a post M^{11} in such a manner that when the lever M^5 is at its normal position, as shown in Fig. 3, the pawl M^4 is out of engagement with the ratchet M^3 .

The receiver-hook K is secured to a shaft K' , on which shaft is also secured an arm K^2 , one end of which carries a pin K^3 . Secured on a block at the side of the telephone-box and in the path of the pin K^3 is a bell-crank lever 66, the horizontal arm of which is flexible and the outer end of which has a curved lip of the same character as that illustrated in another similar piece in Fig. 8. This horizontal arm is so arranged that when the receiver is hung upon the hook K the pin K^3 will engage the upper edge of the horizontal arm of 66 and press it downward, while upon the rising of the hook K the pin K^3 will engage the curve lip and press the horizontal arm to one side, thereby passing the horizontal arm without moving the vertical arm from its position. Located at a convenient place in the telephone-box is a bell-ringer Q , on the armature of which is an arm Q' , adapted to engage the end of a catch Q^2 , that en-

gages and holds the bell-crank arm 66 in the position shown in Fig. 2. Adjacent to the arm 66 is a contact-point 67. These parts are so arranged that upon the operation of the bell-ringer Q the arm Q' will strike the catch Q^2 , releasing it from the arm 66, when said arm will be forced by the spring back into contact with the contact-point 67. If after this operation has taken place the receiver be hung upon the receiver-hook K , the pin K^3 will engage the upper portion of the horizontal arm of 66, pressing it downward, and thus pressing the vertical arm back so it will again be caught by the catch Q^2 and be held away from the contact-point 67. On the other end of the arm K^2 are supported an insulated contact-spring 76 and another contact-spring 74, which is in electrical connection with the arm K^2 , and consequently with the shaft K' and the receiver-hook K .

Adjacent to and in the path of the contact-springs 74 and 76 is a strip 73, having contact-points 73^a and 73^b at its two ends, as shown in Fig. 2. Midway between the two contact-points on the metallic strip 73 is an insulated contact-point 77. In Fig. 2 the hook K and the contact-springs 74 and 76 are shown in their mid-position. When the receiver is on the hook K , the contact-spring 74 is in the position in which 76 is shown, and 76 is in a position above the contact-point on the upper end of 73. When the receiver is removed from the hook K , the contact-spring 76 is in the position of contact-spring 74, as shown in Fig. 2, and the contact-spring 74 is below the contact-point on the lower end of 73. It will therefore be evident that in the movement of the receiver-hook from the upper extreme to the lower the contact-spring 76 will engage the contact-point 77, and at the same moment the contact-spring 74 will engage the lower contact-point on the strip 73. In the passing downward of the receiver end of the hook K these springs will pass upward over these points, then pass out of connection with them into the position shown in Fig. 2, and following this the contact-spring 74 will engage the contact-point 77, while at the same time the contact-spring 76 will engage the upper contact-point on the strip 73, after which further movement will cause these strips to pass out of engagement with the said contact-points. Also located on the shaft K' is another metallic piece K^4 , having two arms nearly horizontal and the third arm K^5 projecting upward. One of the horizontal arms of K^4 is connected by G^4 to an arm of the gear-segment G^3 , so that when the receiver is placed upon the receiver-hook K the said segment will be moved so as to turn the gear G^2 , and consequently the ratchet-wheel G^5 and the gear G^7 , the result of which is to give the armature of the generator G two rotations. When the receiver-hook K rises by reason of removing the receiver, the

segment G^3 rotates the gear G^2 and ratchet-wheel in the opposite direction, in which case the ratchet-wheel moves under the pawl G^0 and the armature is not rotated. It will therefore be apparent that when the receiver is placed upon the hook K the result is to give the generator two rotations, making two electrical connections between 46 and 45, while, on the other hand, the rising of the hook K, due to the removing of the receiver, does not in any way affect the armature of the generator.

The segment G^3 is so related to its movement that when the receiver-hook K is at its lowest or at its highest position the segment is free from the gear G^2 , and consequently the said gear and the armature of the generator may be rotated without interfering with the segment G^3 or the hook K. The other horizontal arm of the metallic piece K^4 is provided with a rod M^9 , which passes through a tailpiece on the holding-pawl M^8 . On the rod M^9 is an adjusting-nut M^{10} , which may be set at any required position. These parts are so arranged that upon the descent of the hook K by reason of the receiver being placed upon it the rod M^9 will descend so that the nut thereon will engage the tailpiece on the pawl M^8 , thereby releasing said pawl from the rack M^3 , so that said rack and the slide M to which it is connected may fall by gravity to its normal position.

Located on the cover of the telephone-box near its upper portion is a bell-crank lever 43, the horizontal arm of which is flexible and reaches outward into the path of the holes M^2 in slide M. The end of the horizontal arm of the bell-crank 43 is provided with a lip W, which is given a curve, as shown in Fig. 8. The other end of the bell-crank 43 is arranged so as to engage either of two contact-points 42 and 57, which are secured to the cover of the telephone-box. On the lower end of the bell-crank 43 is a pin K^6 , that lies in the path of the arm K^5 on the metallic piece K^4 .

Secured near one corner of the telephone-box are two brackets V^4 , in which is supported a vertical shaft or rod V^5 . Loosely mounted on the shaft V^5 is an arm V^6 , the free end of which constitutes a pin adapted to be inserted into any one of the series of holes M^2 in slide M. When the pin is thus inserted into one of the holes M^2 , it projects through so that when the slide M is moved upward the said pin will engage the lower part of the horizontal arm of the bell-crank 43, moving it upward and shifting the other arm from the contact-point 42 to contact-point 57. When the receiver is placed on the hook K, the movement of the arm K^5 engages the pin K^6 on the bell-crank 43 and moves the said bell-crank from contact-point 57 to the contact-point 42. When the pin V^6 passes above the horizontal arm of the bell-crank 43, and in the downward movement of the said pin,

due to the falling of the slide M by gravity, said pin will engage the curved part W of said bell-crank, pushing it outward and passing below it without otherwise disturbing said bell-crank 43. Secured to a convenient place on the lower portion of the slide M is a bracket V, to which is secured an insulated plug V' .

Secured to the bottom of the telephone-box and in the path of the plug V' are two contact-springs 25 and 39, so arranged that the plug V' may enter between them and press them back. In their normal position the springs 25 and 39 are in contact with contact-points 90 and 23; but when the plug V' enters between the said springs 25 and 39 it will push them out of engagement with the contact-points 90 and 23 into electrical connection with the contact-points 24 and 40. These springs, their contact-points, and the plug V' constitute a current-reversing switch, the use of which will appear in the description of the circuits hereinafter to be given. The location of the plug V' with respect to the springs 25 and 39 and also with respect to the pointer V^3 on the front of the slide and the graduations on the guides adjacent thereto is such that the plug V' emerges from between the springs 25 and 39 immediately after the pointer V^3 rises above the graduation marked "0."

The upper hole M^2 in the slide M is so related to the bell-crank 43 and to the movement of the plug V' in the springs 25 and 39 that immediately upon the emergence of said plug from engagement between the springs 25 and 39 the pin V^6 , if located in the upper hole M^2 , will engage the bell-crank 43 and shift it from connection with 42 to 57. These various parts are arranged for hundreds and units. The pointer V^3 and the graduations which are adjacent thereto represent hundreds, and the holes in the slide represent units. For example, the position shown in Fig. 1 illustrates the keyboard or indicator set for 930—that is, the pointer V^3 is set at 9 and pin V^6 is set at 30. In this position when the slide M is moved upward by virtue of rotations of the generator nine electrical contacts will be made between 46 and 45 before the plug V' emerges from between the springs 25 and 39, and following this there will be thirty contacts between 46 and 45 before the pin V^6 engages the bell-crank 43 and moves it from contact-point 42 to contact-point 57. If the slide M be moved upward by hand, so that the pointer V^3 will be adjacent to some other graduation, then the number of contacts made before the plug V' emerges from between the springs 25 and 39 will be correspondingly reduced and will be equal to the number indicated on the graduation. If the pin V^6 be placed in some other hole than that numbered "30," the number of contacts made after the time of the plug V'

leaving the springs 25 and 39 will be correspondingly greater or less according to the position in which the pin V^6 is placed.

The devices at the central office do not form a part of the present application, but are illustrated diagrammatically for the purpose of showing the circuits over which electrical currents pass as a result of contacts made by the call mechanism. These devices consist, primarily, of a switching mechanism having insulated portions, (represented by the bars H and H' in Fig. 9.) There are contact-makers P, which are in electrical connection with the bar H, and other contact-makers P' in connection with the bar H'. The contact-makers are arranged in pairs and are movable over contact-points which are connected to different wires of a bank of wires 91.

B represents a magnet used for selecting a particular pair of contact-makers, and A represents another magnet used for moving the selected pair of contact-makers over their contact-points.

The construction and operation of these parts are fully shown and described in the application from which this is a division.

There is a switching mechanism for each telephone in the exchange, and adjacent to each switching mechanism are magnets C and D. The magnet or relay C is an ordinary one arranged to operate with a very light current and is provided with two armatures which have their ends polarized, as shown at N and S, representing north and south poles of the magnetized armatures. It is also made with sufficient resistance to prevent short-circuiting a talking-circuit including lines 32 and 34.

When a current from the generator is sent through the relay C in one direction, it attracts the armature which has its north end adjacent to the pole of the relay, and when a current is sent in an opposite direction through the relay it attracts the armature which has its south end adjacent to the pole of the relay. Connected to those two armatures N and S of the relay C are two contact-closing devices, one of which is connected to the magnet B of the switch and the other of which is connected to the magnet A. It will therefore be apparent that if a current be sent through the relay C in one direction an electrical connection will be made through with which a current may pass through the magnet B, while if a current be sent through the relay C in the opposite direction a contact will be made by which an electrical current may be made to pass through the magnet A. There is located at a convenient place in the central office a battery X, from one side of which battery a wire 100 extends with branch connections to the frame C' of the magnet C of each switch in the exchange. It is to this frame C' that the armatures N and S are pivoted, so that when a current

passes to the frame C' it may pass through either contact-closing device to either contact-point 47 or 51, and thus to either magnet B or magnet A. From the other side of the battery X a wire 50 extends through the exchange with branches to magnets B and A on each switch. The magnet D is arranged to operate under a very light current and has its armature D' adjusted very close to the pole of the magnet; and said armature is part of the electrical circuit which passes through the magnet D and through the contact-point 71. The talking-circuit passes through the magnet D, but is not powerful enough to operate it. If, however, any other electric current—as, for example, a current from the generator G—passes through the magnet D, it will be sufficiently powerful to actuate such magnet and break the connection between D' and 71, so that a current passing through the magnet D cannot pass by way of D' except for a fraction of its duration. From contact-point 71 the wire extends to the bar or support H' of the switch, and from the magnet D a wire 32 extends to a binding-post 31 on the telephone-box of the telephone which belongs to that particular switch. From the bar or support H of the switch a wire 34 extends to a binding-post 35, also on the same telephone-box. From the wire 34 there is a branch to the relay C, and from the relay C a connection 33 to the magnet-frame D'. The various contact-points in the telephone-box, most of which have been described and all of which will be apparent by examining the diagrams in Fig. 9, are connected up by wires in the manner illustrated in said diagram.

Assuming that a subscriber wishes to call another subscriber, he first sets the pin V^6 into a hole representing the number of units which are in the number representing the subscriber whom he desires to call. He then removes his receiver and adjusts the slide M so that the pointer V^3 is opposite the number of hundreds of the subscriber whom he wishes to call. He then turns his crank G' until the bell rings. He then has electrical communication with the subscriber with whom he desires to talk, and said subscriber has been duly notified. The operation of removing his receiver, setting his indicator, and turning the crank G' are all the operations that he performs in calling any given subscriber in the exchange. All the other operations are automatic and are as follows: Upon turning the crank of his generator said generator is not in electrical connection with any line except at the moment when the disk 46 engages the contact-spring 45. As this point is always at a given portion of the rotation of the generator-shaft a current sent from the generator is always in one direction from the armature and to the line beyond contact-spring 45. Upon each connection between

46 and 45 a current flows from generator as follows: 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, D, D², 33, C, 34, 35, 36, K, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 20. This is a complete circuit in one direction through the relay C, which causes said relay to attract the armature N, closing connection between C' and 47, when a current flows as follows: X, 100, C', 47, 48, B, 49, 50, X.

The operation of the generator operates the relay C and causes impulses to be sent through B, which in turn selects a pair of contact-makers. This operation is continued until the plug V' passes out of its engagement with the springs 25 and 39 after nine impulses representing hundreds have been sent to central, when said springs move into connection with the contact-points 23 and 90. When that occurs, the current then flows 20, 21, 22, 23, 39, 38, 37, K, 36, 35, 34, C, 33, D², D, 32, 31, 30, 29, 28, 27, 26, 25, 90, 40, 41, 42, 43, 44, 45, 46, 20. This is an electrical impulse sent in an opposite direction through the relay C, which attracts the armature S, making electrical connection with the contact-point 51, when a current flows as follows: from battery X, 100, C', S, 51, 52, A, 53, 50, X. This energizes magnet A and moves the contact-makers P and P' upward step by step to succeeding contact-points in rows of contact-points. When the slide M' has been moved upward far enough by repeated rotations of the generator 20 so that thirty impulses have been sent, the pin V⁶ will engage the bell-crank 43 and shift it from contact-point 42 to 57. Then the current from the generator is shifted from relay C to ground through a bell-ringing device as follows, Fig. 9: 20, 21, 22, 23, 39, 38, 37, K, 36, 35, 34, H, P, to the selected contact-point 80, to the bank-wire 91, and along the connected wire to the branch 81, Fig. 11, therefrom to the bar H of the selected switch, 34, 35, 36, K, 54 (hook of called switch being down,) 55, 56, Q, ground at the called telephone to ground at calling telephone Q, 56, 55, 57, 43, 44, 45, 46, 20. This operates the ringer of both telephones, which operation causes the arm Q' to release the catches Q² and permit the bell-cranks 66 to be moved into electrical connection with the contact-points 67. The called subscriber removes his receiver, when a primary circuit is as follows: Y, 58, 59, 60, 61, K, 62, Y. The secondary or talking circuit is as follows: 59, 63, 64, 65, 66, 67, 62, K, 36, 35, 34, H, P, to the selected contact-point, 80, 91, to 81, and H of the called switch, 34, 35, 36, K, 62, 67, 66, 65, 64, 63, 59, 68, 69, 70, 27, 28, 29, 30, 31, 32, D, D², D', 71, H', 82, to the line 91, and thence back to 83 of the calling-switch P', H', 71, D', D², D, 32, 31, 30, 29, 28, 27, 70, 69, 68, 59.

To release, the subscribers hang up their receivers. At the calling-station the descent

of the receiver-hook causes the rod M⁹ to engage the tail of the pawl M⁸ and release it from the rack M³, which permits the said rack and the slide M to drop again to their normal position. The descent of the hook also causes the arm K⁵ to engage the pin K⁶ and move the bell-crank 43 from contact-point 57 back to its normal position into engagement with the contact-point 42. The descent of the receiver-hook in moving the arm K⁴ also moves, through the connection G⁴, the segment of a rack G³, which movement causes the generator-armature to make two rotations during the time when the hook is descending. At the same time during the descent of the hook and while the generator is being thus given two rotations the contact-springs 74 and 76 make contact with 73 and 77, which first result, in a current as follows at the instant when the disk 46 engages the spring 45: 20, 21, 22, 23, 72, 73, 74, K, 36, 35, 34, C, 33, D², D, 32, 31, 75, 76, 77, 78, 45, 46, 20. This current through C attracts the armature S and makes an electrical circuit from battery X through the magnet A precisely as has been previously described. Immediately thereafter during the further descent of the hook and at the instant when the disk 46 engages the spring 45 in the second rotation of the generator this previously-described current through C is reversed as follows: 20, 21, 22, 23, 72, 73, 76, 75, 31, 32, D, D², 33, C, 34, 35, 36, K, 74, 77, 78, 45, 46, 20. This reversal of the current through the relay C closes the connection of the magnet B when a current flows through that magnet from the battery X, as has been previously described.

The current through the magnet A immediately followed by a current through the magnet B is the electrical part of the operation which causes the switching mechanism to return to its normal position. Also in the descent of the receiver-hook the pin K³ engages the upper portion of the bell-crank 66, pushing it downward until said pin passes out of engagement with said arm, which movement of the bell-crank causes it to be moved away from contact-point 67 and to be engaged and held by the catch Q².

It will be observed that the operations of calling a subscriber are very much simplified and are arranged so that there is a small chance of error. By using a keyboard or indicator which is set for any required subscriber and which may be observed by the calling subscriber before he operates his generator the chances of error rising from selecting numbers during the process of calling is eliminated. As soon as he has set his indicator or keyboard and is satisfied that it is at the right indication the only operation required of him is to turn the generator-crank G' until the bell of his generator rings. While turning the crank G', the slide M and the pin V⁶

are moving upward directly before his eyes. By reason of the termination of the teeth of the ratchet-bar M^3 after the slide is moved up a certain distance, which would be equal to the greatest number of indicating-marks on the slide M , further rotations of the generator will not raise the slide and the pin V^6 . The upward movement of the said slide does not stop at the instant that the proper connection is made to the required telephone, but proceeds upward until the end of the ratchet M^3 is reached or until the subscriber stops turning the crank C' . The bell, however, begins to ring the instant the proper connection is made to the required subscriber, because upon the connection being made the pin V^6 moves the bell-crank 43 from connection to its switch mechanism to connection with the bell-ringing device, so that the bell rings immediately. From this it will be apparent that if the subscriber in turning his crank observes that his indicating-slide M no longer advances upward and the bell has not rung at the time when it stops it will indicate to the calling subscriber that the one to whom he wishes to talk is busy. The reason for the bell not ringing is as follows: It will be observed by the diagram that a current passing to the bell-ringer Q must go by contact-point 54 through the hook K or by contact-point 57 through the bell-crank 43. At the calling-telephone the subscriber has removed his receiver, so that the connection between K and 54 is broken. He therefore can reach the bell-ringing device only when the bell-crank 43 is moved to 57, which, as has been previously shown, occurs when the pin V^6 reaches the said bell-crank. In the called telephone the bell-crank 43 is not moved, but the subscriber's receiver-hook is down in its normal position, if he is not busy, in which case a current passes to the called subscriber through the receiver-hook. From this it will be seen that the instant a called subscriber removes his receiver he can no longer be reached through the bell-ringing device. As the bell-ringing devices of the called and calling subscribers are in one and the same circuit, it will be evident that if the calling subscriber cannot ring the bell-ringing device of the one to whom he wishes to converse it will be evident that he cannot ring his own. It will also be apparent that the talking-circuit is at all times between the contact-points 67 and the bell-crank 66, that this connection is normally disengaged until operated or released by the bell-ringer. From this it will be apparent that as the calling subscriber cannot operate his bell-ringer when he moves his switch to a telephone that is busy that this inability to operate his ringer prevents him from completing the talking-circuit at his own telephone between 66 and 67. The bell-crank 66 and contact-point 67, together with the ringer Q , form what may be called a

"non-interfering" device, which in this case is purely mechanical, operated or brought into operation by an electrical device.

The arrangement of numbers on the keyboard or indicator, as illustrated in Fig. 1, is made for hundreds and any number of units up to ninety-nine, if desired. It is not necessary, however, that the division between units and hundreds be in this particular form. For example, if the limit number of the telephones in the exchange is six hundred and twenty-five, there may be six graduations for hundreds and ninety-nine graduations for the units, in which case the greatest number of contacts made for any selection would be six plus ninety-nine, which is one hundred and five contacts as the greatest number. There might, however, be ten graduations for the hundreds and sixty-three graduations in the units, in which case there would be as the greatest number of contacts made ten plus sixty-three, equals seventy-three contacts. By making twenty-five graduations in the hundred and twenty-five graduations in the units there would be also a combination of six hundred and twenty-five telephones; but the greatest number of contacts made would be twenty-five plus twenty-five, equals fifty.

What I claim is—

1. The combination with a generator, means for operating it, means for causing electrical impulses to be sent by said generator at certain specified points in its rotations, and a circuit over which impulses are sent, of an indicator, connections from said generator to said indicator for causing a movement of the indicator for each electrical impulse sent by said generator, means for setting said indicator for any required number of impulses, and means whereby upon the completion of the number of impulses for which said indicator was set, said indicator will cause succeeding impulses to be sent over said circuit in a reverse direction.

2. The combination with an electrical generator, means for operating it, means for causing electrical impulses to be sent by said generator at certain specified points in its rotations, and two circuits over which the impulses may be sent, of an indicator, means for setting said indicator for any required number of impulses sent over one of said circuits in one direction and any required number in the opposite direction over the same circuit, means whereby said indicator will control such impulses so as to cause their number and direction to correspond to the number and direction for which said indicator was set, and means whereby upon the completion of the total number of required impulses said indicator will cause succeeding impulses to be sent over the other circuit.

3. In a selecting device for automatic telephone-exchanges a slide and guides therefor,

a series of numbers on the face of said slide, opposite each of which numbers is a suitable hole, a pin or plug adapted to be inserted in any one of said holes, means for moving said slide in its guides, and a switch or circuit-changing device located in the path of a pin in any one of said holes, said switch being arranged to shift an electric current from one circuit to another when engaged by said pin.

4. In a selecting device for automatic telephone-exchanges, a slide and guides therefor, a series of graduations located on one member and a pointer located on the other member, means for setting said slide with the pointer at any required graduation, a device for sending a series of electrical impulses and a current-reversing switch through which such impulses are sent, connections from the impulse-sending device to said slide for moving it one step for each impulse sent, and means whereby said slide will operate said current-reversing switch when the number of impulses sent corresponds to the graduation at which said pointer was set.

5. In a selecting device for an automatic telephone-exchange, a slide and guide therefor, a pin or projection adapted to be connected to said slide at any one of a number of different positions, a switch adapted to shift an electrical current from one course to another when engaged by said pin, a current-reversing switch, a device connected to said slide for operating said current-reverser when said slide has been moved to a particular position, an electric circuit including the current-reverser and the first-mentioned switch, a device for sending a series of electrical impulses over said circuit, and connections from said impulse-sending device to said slide for moving it, the movement of said slide operating first the current-reverser and subsequently the first-mentioned switch.

6. In a selecting device for automatic telephone-exchanges, a vertically-movable slide, a pin adapted to be inserted at different positions in said slide, and a pivoting-support for said pin, said support being arranged to permit said pin to move with said slide.

7. In a selecting device for automatic telephone-exchanges, a slide and guides therefor, a projection on said slide by which it may be moved by hand to any position in its guides, a ratchet and pawl by which it is held in any given position, a propelling-pawl, and means for operating said propelling-pawl so as to move said slide.

8. The combination with a switching mechanism, a generator, a bell-ringer, and a receiver-hook, of an indicating and controlling device, connections from the generator to said device for moving it to correspond to impulses sent by said generator, means whereby the movement of said device will control such impulses so that they will cause a required series of movements of the switching

mechanism and then cause an operation of the bell-ringer, and means for causing said device to be returned to its normal position by a movement of the receiver-hook.

9. In a selecting device, an electrical generator, an electric circuit and a contact-closing device so arranged that an electrical impulse will be sent over said circuit once during each rotation of the armature of said generator, means operated by the rotation of said generator for reversing the direction of such impulses after a predetermined number have been sent in one direction, means for shifting such impulses to a different course after a predetermined number have been sent in the reversed direction, and an adjustable indicator for controlling the number of impulses sent in each direction over said electric circuit.

10. The combination with a generator for sending a continuous series of impulses, and an indicator for controlling the distribution of such series of impulses, of means by which said indicator may be set by hand to vary the distribution of impulses, and means for causing an additional movement of said indicator by the operation of said generator.

11. The combination with a generator for sending a continuous series of impulses, and an indicator for controlling such continuous series of impulses, of means for moving said indicator by the movement of said generator, and a current-reversing switch operated by the movement of said indicator.

12. The combination with an electrical generator, means for rotating its armature by hand, and automatic means for accelerating the speed of the armature at one part of its rotation, of a contact-making device, and means for closing said contact-making device by the rotation of the armature at the time when it is automatically accelerated.

13. In a station-selecting device provided with means for sending a series of electrical impulses, a switch arranged to automatically reverse the direction of such impulses after a predetermined number have been sent, a second switch arranged to automatically shift the impulses from one course to another at a predetermined point in the series, and means by which said device may be set so as to cause said switches to act at any desired points in the series.

14. The combination with an electrical generator for sending a series of electrical impulses, and electrical circuits over which such impulses may pass, of devices for controlling the direction and course of such impulses, and an adjustable indicator by which said devices may be set so as to automatically control the number of such impulses in two directions over one of said courses.

15. The combination with an electrical generator for sending electrical impulses, and electrical circuits over which such impulses

may pass, of devices for automatically dividing a continuous series of such impulses into three parts distinguished by the direction and course over which they pass, and an adjustable indicator by which said devices may be set so that any desired number of such impulses will be in the first two parts and the remainder will be in the third part.

16. The combination with a generator and means for sending electrical impulses therefrom, of a movable indicator provided with means for controlling the distribution of such impulses, and means for operating said indicator by the movement of the generator.

17. The combination with a generator and means for sending a series of impulses therefrom, of automatically-operating devices for dividing said series of impulses into three parts, means by which the dividing devices may be set so that the first division will be at a predetermined number of impulses from the first impulse, and a second means by which the dividing devices may be set so that the second division will be at a predetermined number of impulses from the first division.

18. The combination with a generator and means for sending a continuous series of electrical impulses therefrom, of two switches adapted to divide said series of impulses at

two points, and means for operating said switches successively by the movements of said generator.

19. The combination with a generator and means for sending a series of electrical impulses therefrom, of two switches adapted to divide said series of impulses at two points, an indicator adapted to operate said switches in succession, and means for operating said indicator from said generator.

20. The combination with a telephone selecting device adapted to send a series of impulses, of a crank by which said selecting device is given a primary operation and a receiver-hook by which it is given a secondary operation, means by which upon giving said selecting device a primary operation the desired station of a telephone-exchange will be automatically selected and signaled, and means by which upon giving said selecting device a secondary operation by a movement of the receiver-hook the devices used in selecting will be returned to their normal position.

Signed at Chicago, Illinois, this 30th day of October, 1903.

NILS EMEL NORSTROM.

Witnesses:

THOMAS HAWKES,
WM. A. ROWLAND.