

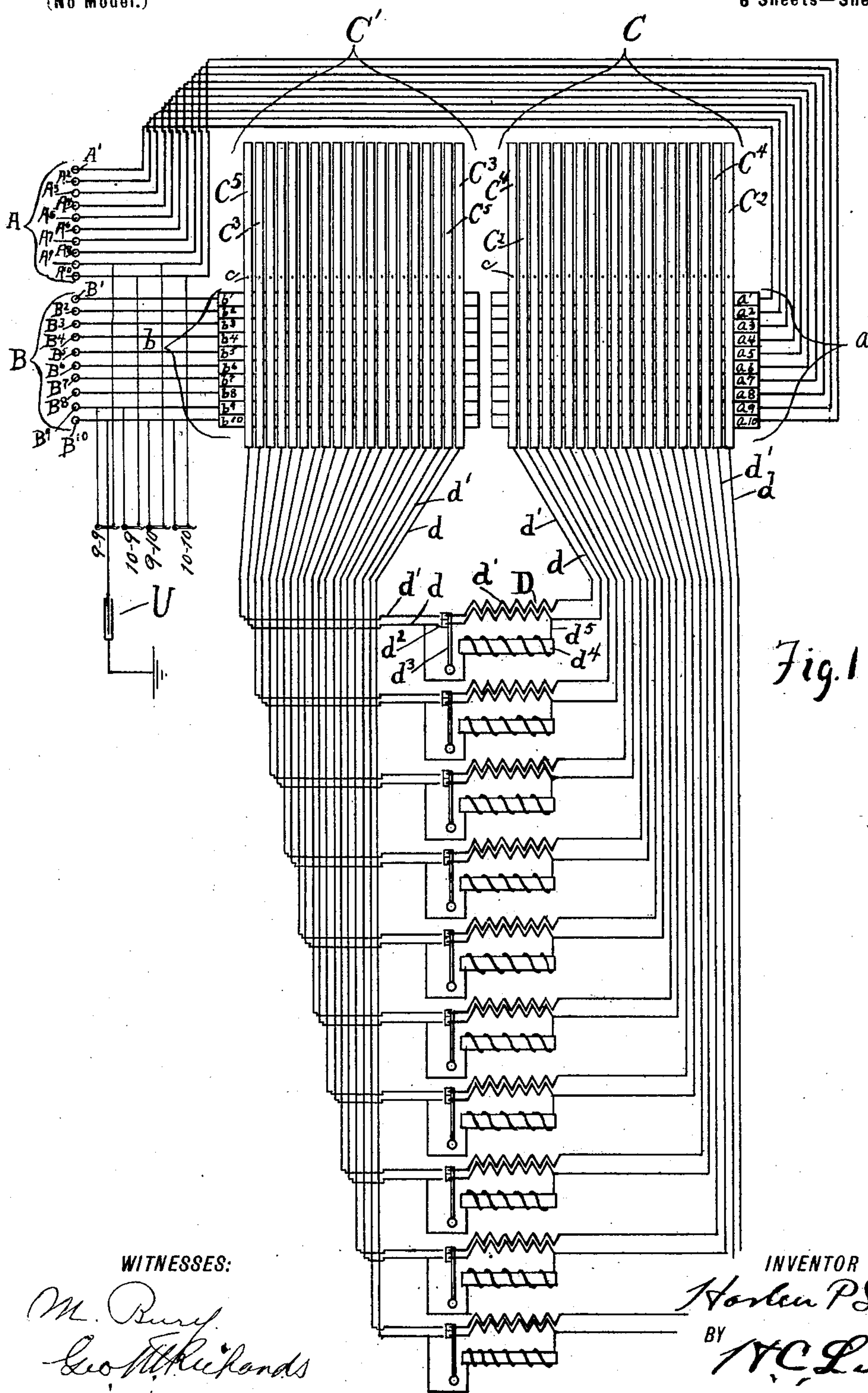
H. P. SNOW.

TELEPHONE EXCHANGE MECHANISM.

(Application filed Sept. 28, 1899.)

(No Model.)

6 Sheets—Sheet 1.



WITNESSES:

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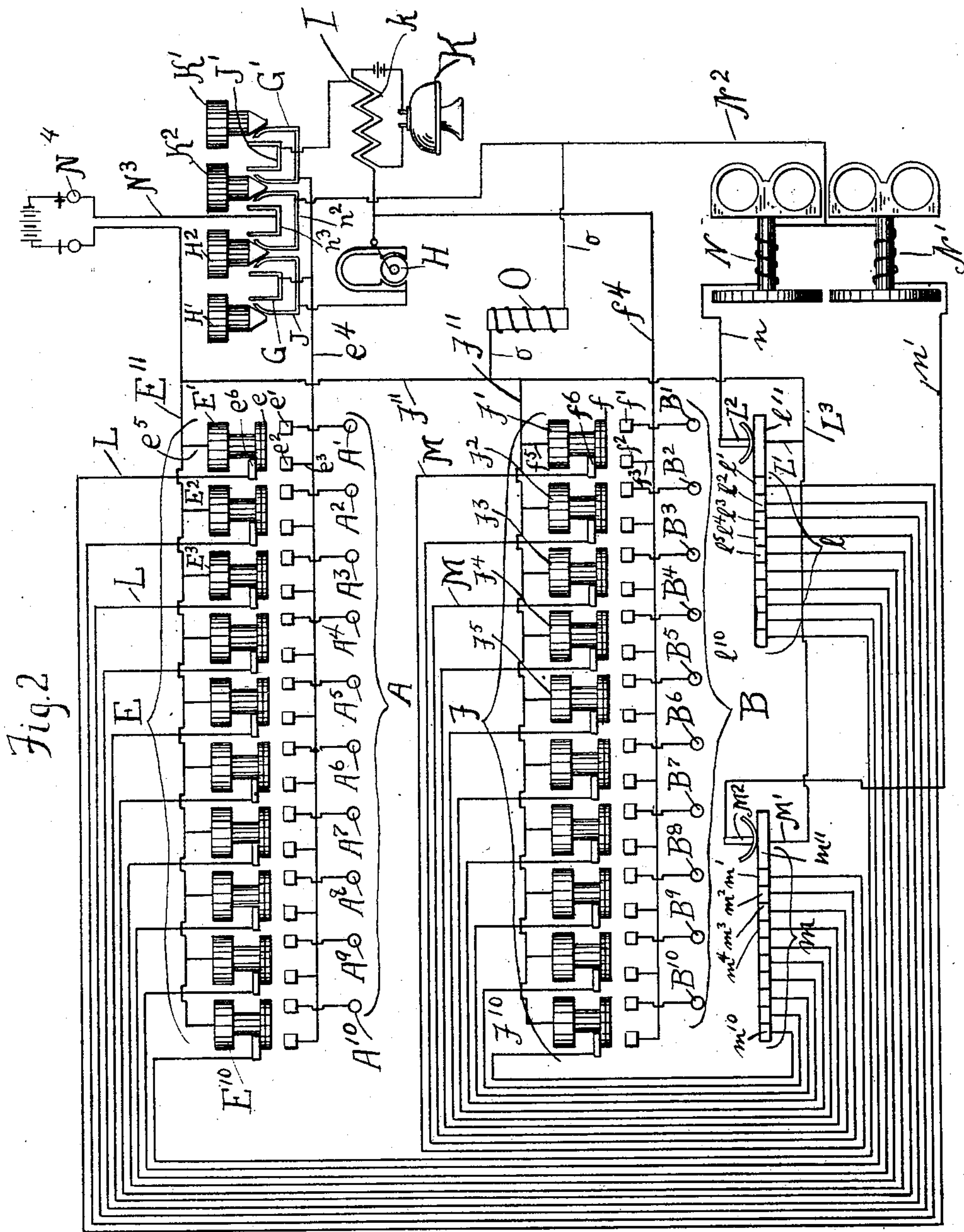
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6 Sheets—Sheet 2.



WITNESSES:

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No. 672,967.

Patented Apr. 30, 1901.

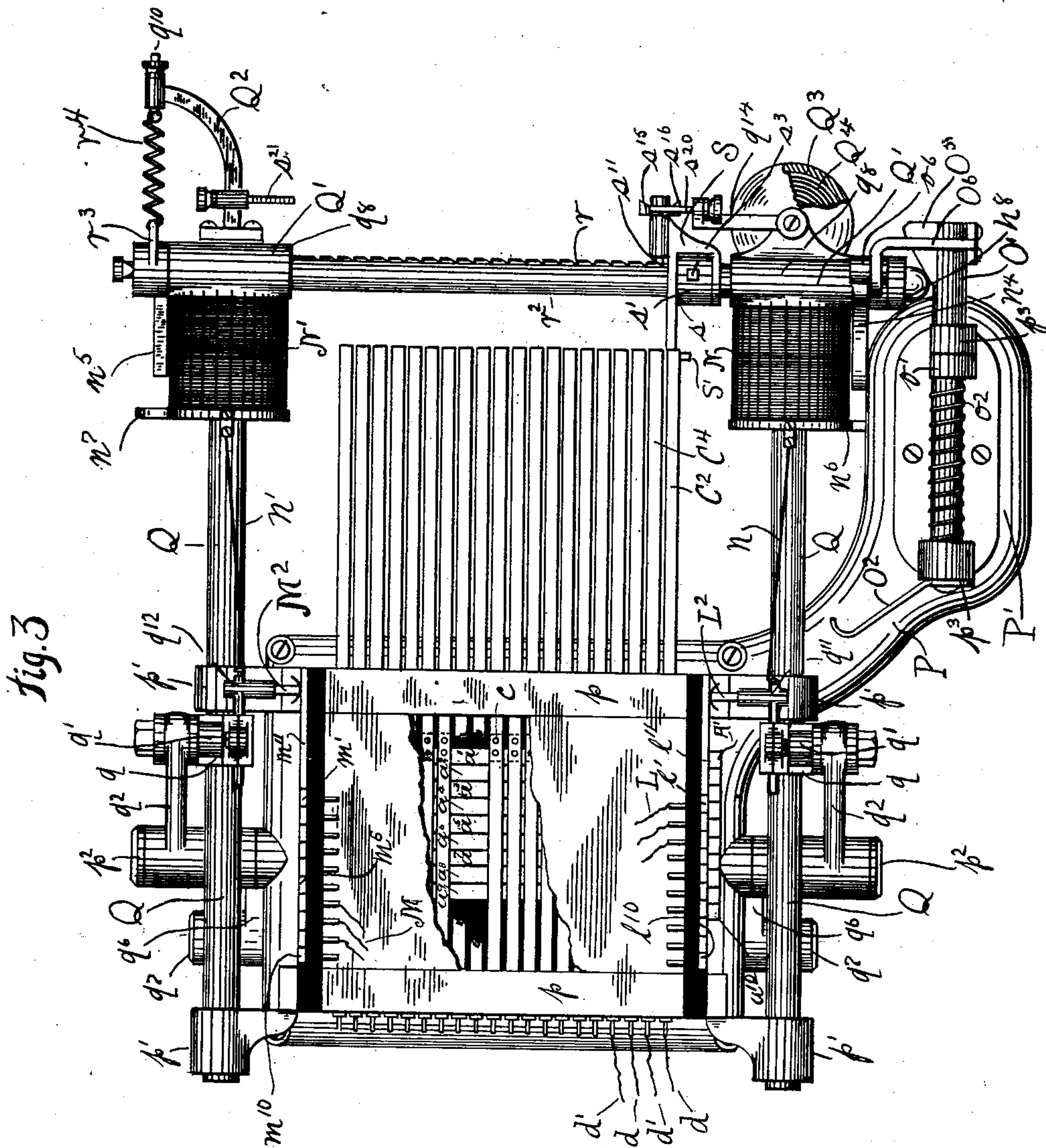
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6 Sheets—Sheet 3.



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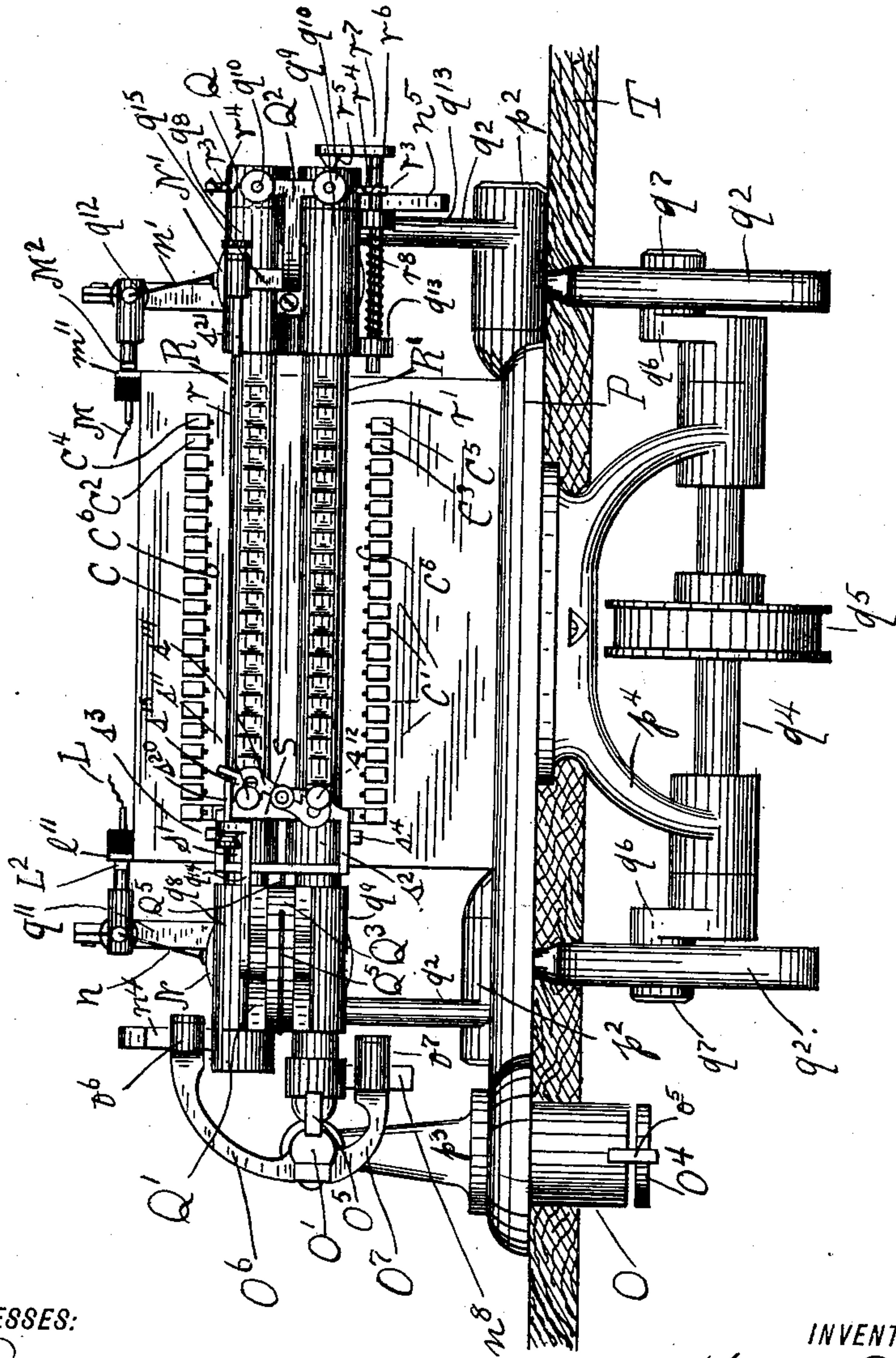
TELEPHONE EXCHANGE MECHANISM.

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6 Sheets—Sheet 4.

Fig. 4



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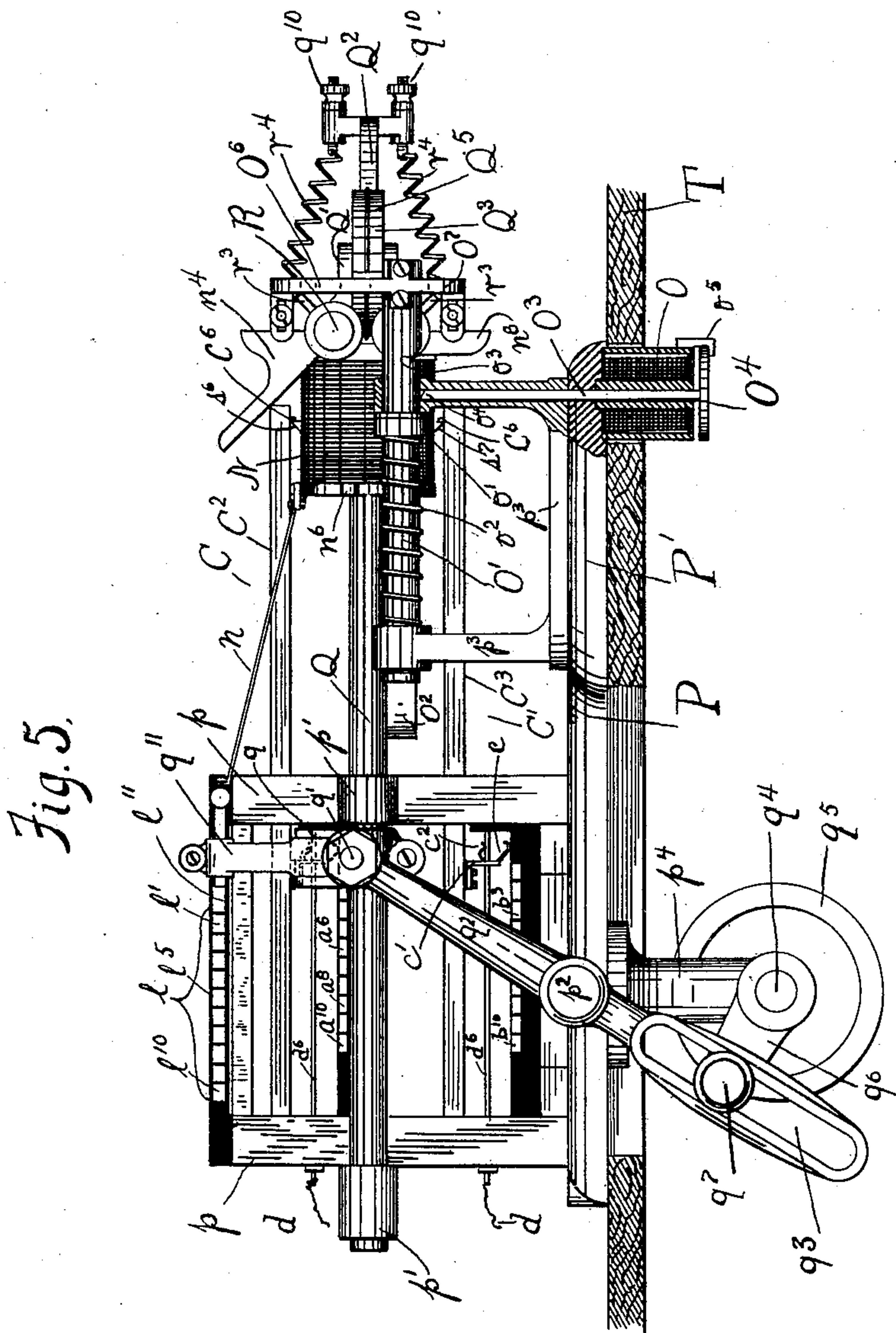
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(Application filed Sept. 28, 1899.)

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6 Sheets—Sheet 5.



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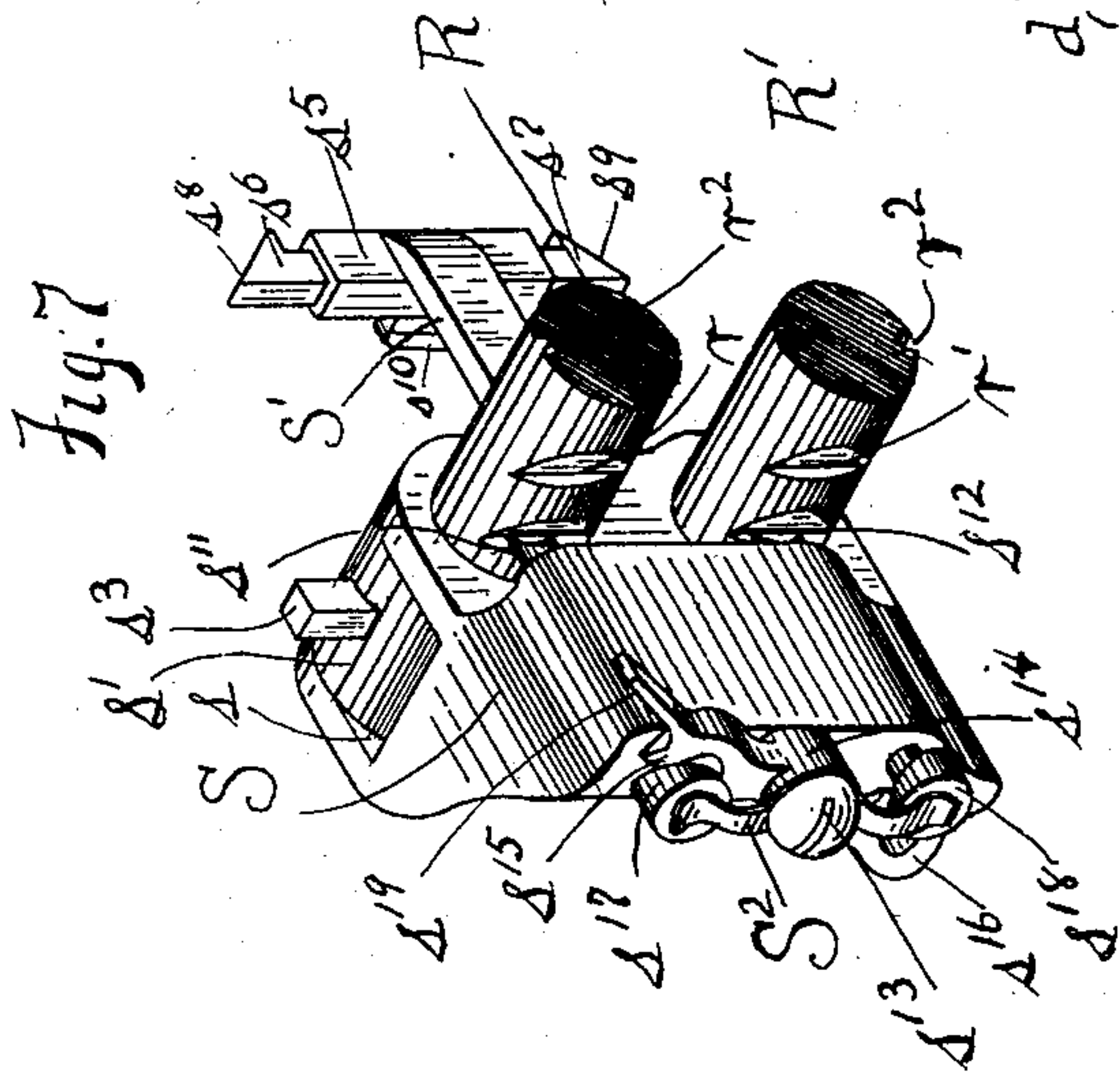
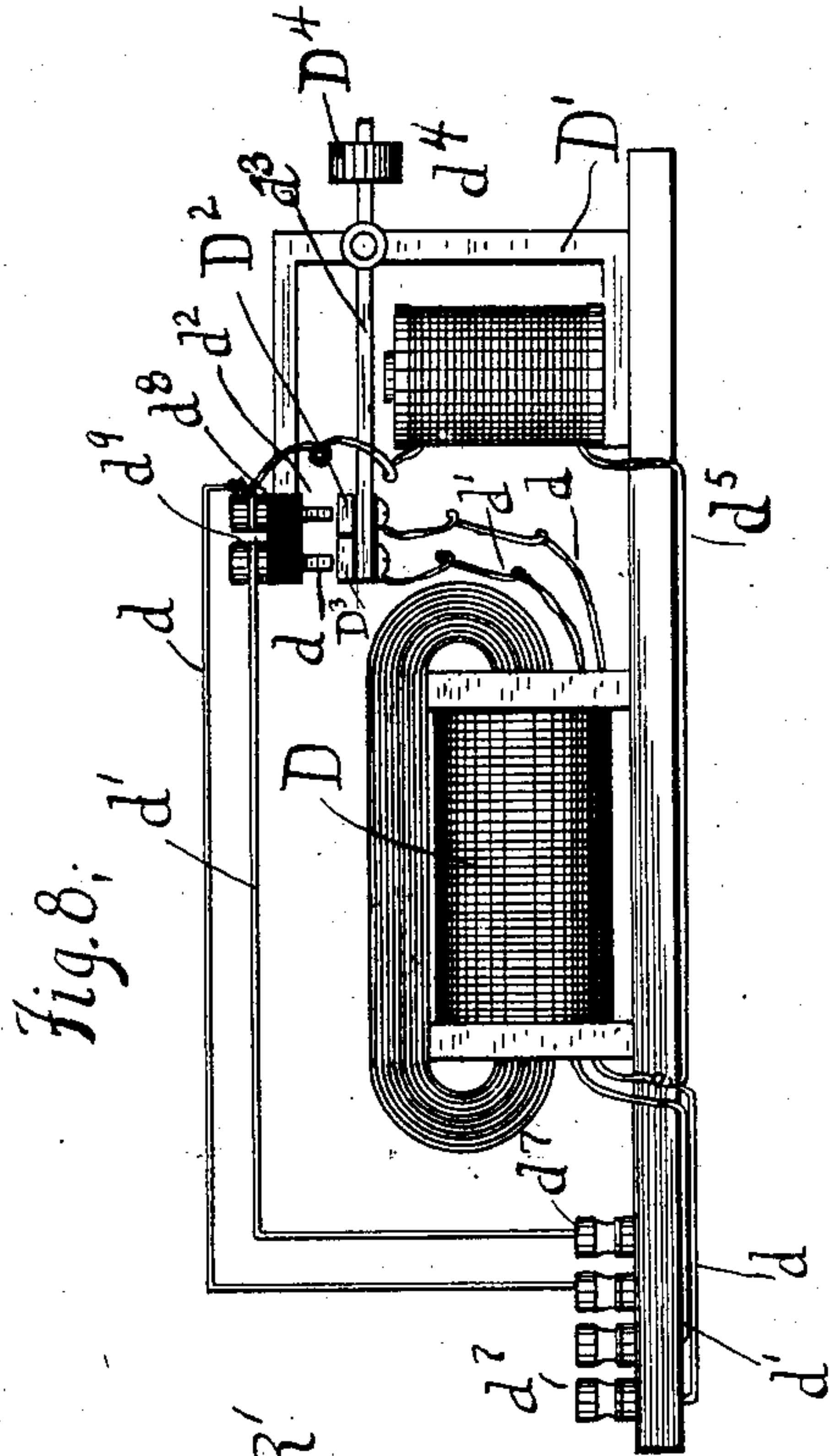
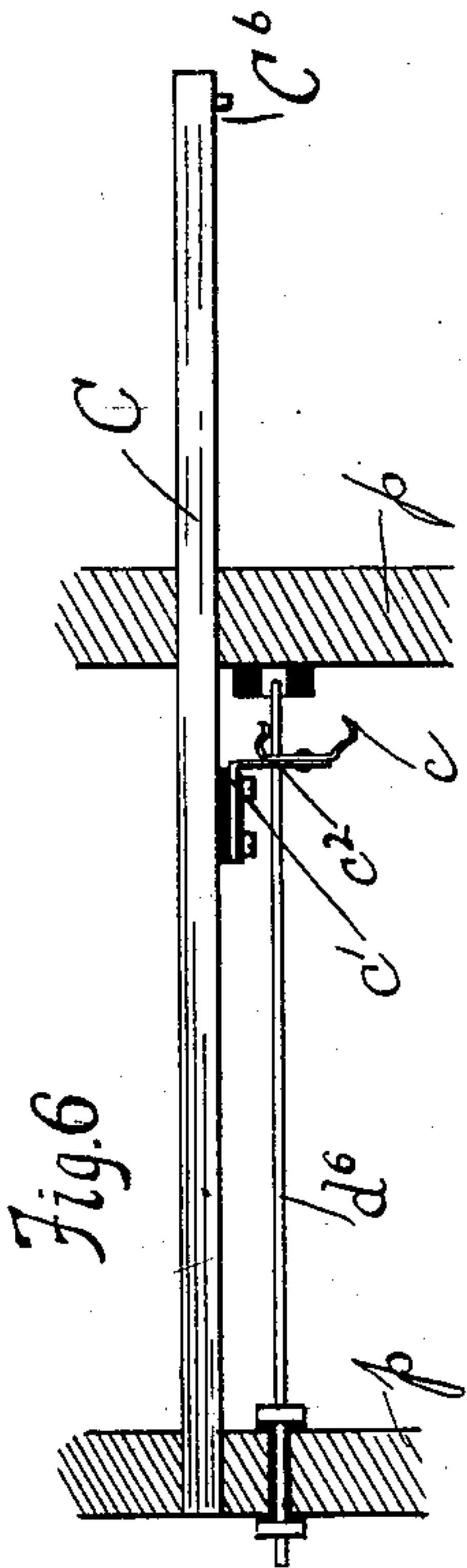
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TELEPHONE EXCHANGE MECHANISM.

(Application filed Sept. 28, 1899.)

(No Model.)

6 Sheets—Sheet 6.



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TELEPHONE-EXCHANGE MECHANISM.

SPECIFICATION forming part of Letters Patent No. 672,967, dated April 30, 1901.

Application filed September 28, 1899. Serial No. 731,994. (No model.)

To all whom it may concern:

Be it known that I, HARLEN P. SNOW, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Telephone-Exchange Mechanisms; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to telephone-exchange mechanism; and it consists in certain improvements in the construction thereof, as will be hereinafter fully described, and pointed out in the claims.

More particularly, the invention comprises among its leading features switching mechanism through which different telephones may be connected, broadly, either by ground or metallic circuits, but more particularly by the system of wiring wherein a series of outgoing wires and a series incoming wires are utilized for a greater number of telephones than the pairs of wires as shown in my patent granted September 28, 1897, No. 590,633.

The mechanism also comprises the detail of the exchange mechanism, which will appear more fully hereinafter.

The invention is illustrated in the accompanying drawings, as follows:

Figure 1 shows a diagram of the switchboard and wiring incident to the connecting mechanism. Fig. 2 shows a diagram of the mechanism controlling the switchboard and the means for actuating the magneto and connecting the exchange-telephone with outside telephones. Fig. 3 shows a plan view of the switchboard; Fig. 4, a front elevation, the point of view being from the right of Fig. 3. Fig. 5 shows a side elevation, the point of view being from the bottom of Fig. 3 and the left of Fig. 4. Fig. 6 shows a detail of the brush mechanism. Fig. 7 shows a detail of the shifting-block mechanism. Fig. 8 shows a large view in detail of the inductive repeater and cutting-out switch.

This exchange mechanism is particularly adapted for operating with the system of wiring shown in my former patent referred to, which consists, briefly, in utilizing a series of

outgoing wires in connection with a series of return-wires by connecting each outgoing and incoming wire with a plurality of telephone systems, each telephone, however, being connected with a different combination of outgoing and incoming wires, so that separate circuits are maintained for each phone.

Referring now to Fig. 1, the general scheme of my switchboard when applied to this system of wiring is shown in diagram. In this diagram, A marks the incoming wires, and B the outgoing wires, the terms "incoming" and "outgoing" wires being used simply for convenience, as, of course, either answers either description. There are ten of the incoming wires in the series, (marked from A' to A¹⁰), and ten of the outgoing wires, (marked from B' to B¹⁰.) The wires A are connected with a series of plates *a*, insulated from each other, and the wires B are connected with a like series of plates *b*, also insulated from each other and separate from the plates *a*. The plates *a* are lettered from *a'* to *a*¹⁰, the plate *a'* being connected with the wire A', and the plate *a*¹⁰ with the wire A¹⁰, with the intervening plates connected with intervening wires in their order. A like system of lettering is employed with regard to the plates *b*, the plate *b'* being connected with the wire B', and so on. Extending across the plates *a* are a series of movable rods, arranged in pairs, C² C⁴. A like series of movable rods C' are arranged over the plates *b* and are also arranged in pairs C³ and C⁵. Contacts *c* are arranged on the rods C C', which are adapted to be brought by the movement of the movable rods into contact with any of the plates *a* or *b*. The rods C² are connected by a wire *d* with the rods C³, and the rods C⁴ are connected by a wire *d'* with the rods C⁵. It will be noted, therefore, that the rods are arranged in couples or pairs, and that each pair is capable of forming a telephonic connection if the wires *d* and *d'* connected with them are connected with a medium to complete a circuit, as the common return-wire. Where a metallic circuit and selecting system described is used, these rods and brushes are also arranged in couples which are in electrical connection—i. e., the rod C² and the rod C³ form a couple or pair which are electrically con-

ected, and the rods C^4 and C^5 also form a pair which are in electrical connection, and the rods C^2 and C^4 form a pair by means of which a telephonic connection may be made.

5 The wires d and d' pass to an inductive repeater which, as shown, is in the form of a repeating-coil D. Each telephone in the system is connected to one of the wires A and one of the wires B, each telephone having a
10 different combination, as many telephones being possible as there are different combinations of the wires, as more particularly pointed out in my former patent referred to. I have shown four telephones connected with
15 the line-wires in this manner. They are numbered 10 10, 9 10, 11 9, and 9 9. The telephone 10 10 is connected with the wires A^{10} and B^{10} . The telephone 9 10 is connected with the line-wires A^9 and B^{10} . The telephone 10
20 9 is connected with the wires A^{10} and B^9 . The telephone 9 9 is connected with the wires A^9 and B^9 . This method of connection is carried out throughout the system. Independent line-wires may run from each telephone
25 into the exchange and there be connected. With this system the switchboard-wire (wires A and B) may also extend out from the telephone-exchange and the wires immediately connected with each telephone simply run to
30 the line-wires. The system of phone-indicators may be and preferably is arranged with two numbers—as, for instance, a phone connected with the wires A^1 and B^1 might be numbered “1 1” and the phone connected with
35 the wires A^4 and B^7 might be designated by the double number “4 7.” In the systems of less than one hundred phones a single number may be used, as “11” for the “1 1” number, above referred to, and “47” for the other;
40 but in large systems the most convenient method is to have the double series of numbers, as above referred to.

The general operation of the device can be readily understood from the diagram shown
45 in Fig. 1 and is as follows: The caller's number is indicated by an ordinary annunciator. (Not shown.) A rod C^2 is moved so as to bring the contact c upon the bar a having connection with the wire corresponding to the
50 first number of the caller's phone, and the rod C^3 is moved to bring the contact c on the bar b having connection with the outgoing wire corresponding to the second number of the caller's phone. The number of the phone
55 of the party called is ascertained, and the rod C^4 , which is connected through the wire d' with the same repeater D, as is the wire d for the rod C^2 already moved, is moved so as to bring its contact c on the plate a correspond-
60 ing to the wire indicated by the first number of the phone of the party called. A similar operation is pursued with reference to the rod C^5 . It is moved to bring the contact c over the plate connected with the wire corresponding
65 to the second number of the phone of the party called. It will readily be seen that as the rods C^2 and C^3 are brought over the bars which

are connected with the outgoing and incoming wire of the caller's phone a circuit is established with the telephone of the party
70 called through the wire d' and coil D. Electrical energy is conveyed from one to the other circuits through induction in the coil D, so that a perfect telephonic connection is established between the caller and the party
75 called.

The rods C and C' , as before stated, are arranged in couples or pairs, and their number is determined by the amount of service that is desired of the switchboard, and there is for
80 each couple of rods C^2 C^4 an inductive repeater D and connecting-wires d d' . The rods are preferably used successively, the rods C^2 , C^4 , C^3 , and C^5 at one end of the series connecting the first caller with the first party
85 called and the next couple or pair of rods being used for the next caller, and so on. After all the rods have been used the first couple or pair of rods may be used if the party is through using the telephone, or, if not, the
90 next adjacent rods may be used, and so on. The number of subscribers in the system determines the number of bars a and b . Practically any number of subscribers may be provided for by increasing the number of
95 bars a and b . From this it appears that the number of rods C and C' determines the capacity for service of the board, and the number of plates a and b determines the number of subscribers.
100

In the use of the system where the same wires are used for different circuits cross-talk may possibly result by reason of the greater capacity of some of the wires than the others. To avoid this result, I provide the wires with
105 the condensers U, which are of the usual form, and by these the capacity of the wires may be equalized, so as to avoid the result referred to.

In order that the connection between two
110 telephones may be automatically broken by the ring of the bell of one of the phones in a circuit, I provide a coil d^4 , arranged on a shunt d^5 , extending from the main circuit through the wire d . This coil is arranged to
115 be a greater impedance than is the coil D and forms a sufficient impediment to prevent a current through it during the ordinary use of the circuit. It is, however, influenced by the current produced by the magneto and
120 when so influenced operates upon an armature d^3 , carrying a switch d^2 , which is thrown out by the movement of the armature incident to the current produced in the coil d^4 by the action of the magneto, and this switch re-
125 mains in the disconnected position until again connected by the operator.

The exchange wiring for setting the mechanism to actuate the movable rods and contact-brushes at c , as hereinbefore described
130 in reference to Fig. 1, as well as the means for ringing the bell of the party called and connecting the exchange-telephone, are shown in Fig. 2. On the operating-board of the ex-

change is arranged a series of spring-actuated press-buttons E and F, one of the buttons E being intended to operate upon each of the wires A, and being lettered E¹ E² E³, &c., to correspond with the letters A¹ A² A³, indicating the wires with which they are to operate, respectively, and the buttons F¹ F² F³ to indicate the button operating with the wires B¹ B² B³, &c., respectively. Each of the buttons is provided with a circuit-closing plate *e*, which is insulated from the rest of the buttons, and the buttons F have the similar plate *f*. Below the plates *e* and *f*, but in the path of said plates, are arranged a series of contact-posts *e'* and *f'*, connected with the wires A and B, respectively. A second series of contact-posts *e''* are arranged in the path of the plates *e*, so as to be connected with the posts *e'* through the plates *e*. The posts *e''* are connected through the wires *e'''* with a common wire *e''''* of the exchange-circuit. The wire *e''''* extends to the switch-posts G and G'. A series of posts *f''* are similarly arranged in the path of the plates *f* and are adapted to be connected through the plates *f* with the posts *f'* when the buttons F are depressed. The posts *f''* are connected through the wires *f'''* with a common wire *f''''* of the exchange-circuit, the wire *f''''* having two branches, one passing through the magneto H and the other through the repeater I to the switch-posts J and J', respectively.

The exchange-telephone K is in circuit with a wire passing through the coil I, so as to be operated by induction from the repeater I. A button K' is arranged to operate upon the switch-post G' to force it into connection with the post J', and consequently close the circuit through the coil I and make a connection with the exchange-telephone. If therefore a caller's number is indicated by an annunciator and the buttons E and F, corresponding to the wires forming the circuit of the caller are depressed, so as to connect those circuits with the wires *e''''* and *f''''*, a circuit is completed with the caller through the coil I and a connection made with the exchange-telephone. A button H' is arranged to operate upon the switch-post J, so as to make a contact between said post and the post G'. It will readily be observed that if this button H' is depressed the magneto is brought into the circuit with the circuit completed through the depression of the buttons E and F, so that a bell in the circuit with the buttons depressed is operated. Ordinarily this is the bell of the party called. Each of the buttons E is connected through wires *e'''* with a common wire E¹¹, which extends to one side of an electric power-producing element N⁴. Each button E is also, when not depressed, connected with a post *e''*, and each post *e''* is connected through a wire L with a series of posts *l*, (lettered from *l'* to *l''''*), one for each plate *a*. As each button E is depressed it is thrown out of contact with the post *e''* which is normally in contact with the button. At the end of the series of contact-

plates *l* is a long contact-plate *l''''*. All these plates are insulated from each other, as are also the wires leading to them. A contact-brush L² is arranged to pass over the plates *l''''* and *l* and is of sufficient width to bridge the insulation between said plates, so that there is a constant current from the electrical producing element N⁴ through the wire E¹¹, wires *e'''*, post *e''*, and wires L to the brush L², unless some of the buttons E are depressed, and when this happens there is a break in the circuit described when the brush L² reaches the contact-plate in connection with the button E depressed. For convenience the contact-plates are lettered *l'* *l''*, &c., in the same order and to correspond with the buttons E¹ E² E³, &c., respectively, and also in the same order as and to correspond to the plates *a'* *a''* *a'''*, &c., as well as the wires A¹ A² A³, &c., operated upon by the action of the buttons E¹ E² E³, &c. Passing from the brush L² is a wire *n*, which passes through a coil N, and the wire N² leads from this coil to a switch-post *n''*. The buttons K² and H² are arranged to operate upon the switch-post *n''* and to form a connection by their operation, as readily seen in said figure, with a switch-post *n'''*. The post *n'''* is connected through a wire N³ with the other side from that connected with the wire E¹¹ of the electrical power-producing element N⁴. The buttons F are provided with a series of posts *f''*, similar to the posts *e''*, and are connected through the wires M with a series of contact-plates, (lettered from *m'* to *m''''*), respectively. At the end of the plates *m* is a long contact-plate *m''''*, similar in function and form to the contact-plate *l''''*, and over these plates is adapted to pass a brush M², similar to the brush L². The brush M² is connected through a wire *n'* with a coil N'. The coil N' is connected with the wire N² leading from the coil N. The lettering of the plates *m'* *m''* *m'''*, &c., is arranged with reference to the buttons F¹ F² F³, &c., and with plates *b* *b''* *b'''*, &c., and wires B¹ B² B³, &c., as are buttons E with the incoming system. The buttons F are connected through the wires *f'''* with a common wire F¹¹, which connects with the wires E¹¹. The general scheme of operation of this part of the mechanism is as follows: The annunciator indicates the wires A and B, forming the circuit of the telephone of the caller. The buttons E and F, operating with said wires, are depressed by the operator and held in that position and at the same time, in ordinary practice, the button K² is depressed. This depression of the button K² connects the wire *e''''* through the switch-block G' with the switch-block J', thus completing the circuit through the coil I, wires *e''''* and *f''''*, and depressed buttons E and F with the phone of the caller. This connects up the short circuit *k* of the exchange-telephone K with the caller's phone. The depression of the button K² also connects the switch-post *n''* with the switch-post *n'''*, thus completing the cir-

cuit through the electrical power-producing element N^4 through the wire E^{11} , wires e^5 , buttons E , posts e^6 , wires L , plates l , brush L^2 , wire n , coil N , and wire N^2 , and this electrical circuit is continued until the brush L^2 is brought over the contact-plate connected with the depressed button, where the circuit is broken. Now if mechanism is provided for moving the rods C , which mechanism is thrown out of action by the breaking of circuit through the coil N , the rod C will be moved until the circuit in the coil N is broken, and if the brush L^2 is moved in unison with the rod C so as to bring the brush L^2 over a plate l when the brush c is brought over a corresponding plate a the current will be broken just as the brush is brought over the plate l connected with the button E depressed, so that the brush c will be stopped on the plate a corresponding to the button E depressed. A similar effect will be produced through the action of the brush M^2 and coil N' with relation to the rods C' and the contact-points c on said rods relatively to the plates b . In order that the long contact-plates l^{11} and m^{11} may complete the circuit from the wire E^{11} before the starting of the brushes L^2 and M^2 , the plates l^{11} and m^{11} are connected by the wires L' and M' , respectively, with the wire L^3 , which is connected with the wire F^{11} , and consequently with the wire E^{11} . As soon as the brushes L^2 and M^2 pass off of the plates l^{11} and m^{11} this circuit is broken, so that the circuit through the brushes is carried through the plates l and m , as heretofore described.

A preferable means for actuating the rods C and C' is through the medium of a mechanism having constant reciprocating movement. This mechanism should not, of course, actuate a rod C' with each movement, but only when it is desired to make the connection. In order that mechanism may be set to actuate the rods C and C' when a connection is desired, a coil O is arranged in a wire o , connecting the wire N^2 with the wire F^{11} . By following the wiring it will readily be seen that if either the keys K^2 or H^2 are depressed this coil is thrown into circuit with the electrical power-producing element N^4 . By arranging the setting mechanism to be actuated by the coil O a reciprocating mechanism may be had which normally does not actuate the rods C and C' , but which may be made to do so when a connection is desired.

In the mechanism shown in carrying out the inventions just described the same designating characters are used for the same parts as are used in the diagrams. Keeping in mind the general scheme of wiring and the objects to be attained, as described in the description of the diagrams, the operation of the specific mechanism for carrying out these purposes will be readily understood.

The device is mounted on a base-plate P , which is secured to the operating-table T . Two uprights p are arranged on the base P , one in front of the other and of sufficient

distance apart to permit the arrangement of the plates a and b , one group above the other, between them and parallel to them. The uprights p are provided with a series of perforations the size of the rods C and C' , and the rods C and C' extend through these perforations, the rods C over the bars a and the rods C' over the bars b . The rods C and C' are of sufficient length to extend outwardly in front of the front plate p , so that they may be moved inwardly a sufficient distance to carry a contact-brush over all the bars a and b . The rods C^2 are preferably arranged directly over the rods C^3 and are so shown, and the rods C^4 are preferably arranged directly over the rods C^5 and are so shown. The bar a' is preferably directly over the bar b' and is so shown, as are the other bars a arranged over the respective bars b in their order. Extending between the uprights p over the bars a and b and parallel to the rods C and C' , are a series of contact-rods d^6 , one for each rod C and C' . (See Fig. 6.) These rods are insulated from the uprights p and are connected with the wires d and d' . Brushes c extend from the rods C and C' onto the plates a and b and are arranged to be passed over the plates a and b by a movement of the rods C and C' with spring-pressure. The brushes are positioned at c , as indicated in the diagram shown in Fig. 1. These brushes are secured to the rods C and C' by the bracket c' , which is insulated from said rods, and to insure a continuous connection with the contact-rod d^6 a second spring-brush c^2 is arranged on the bracket c' , in position to contact the rod d^6 . It will readily be seen that if a brush c on a rod C is brought onto a plate a and a brush c on the corresponding rod C' is brought onto a plate b a connection will be established through the wire d or d' , as described with relation to the diagram shown in Fig. 1. The contact-plates are arranged extending across the space between the uprights p at the left of the machine, and the contact-plates m are similarly arranged at the right. The plates l and m are of exactly the same width as the plates a and b and have the same thickness of insulating material between them, so that if the brush L^2 and brush c are moved together over the plates e and a at the same time they will move over the various plates in their order in proper time, so that when the current is broken with the brush L^2 in contact with any of the plates l the brush c at the same time will be over the corresponding plate a . A similar arrangement is provided with relation to the brush M^2 and the bars b .

Extending from the uprights p are the perforated ears p' , which form guides for the reciprocating rods Q , one at each side of the machine. Secured to the rods Q are grooved cross-heads q . In the grooves of these cross-heads pins q' , carried by the rock-arms q^2 , operate. The rock-arms q^2 are journaled on pins p^2 , secured to the frame, and extend, prefer-

ably, below the operating-table T. Slots q^3 are arranged in the lower ends of the arms q^2 . A shaft q^4 is journaled in the hanger p^4 , extending from the bottom of the base P, and is provided with the drive-pulley q^5 , which may be connected with any source of power. At each end of the shaft q^4 is a crank q^6 , both arranged at the same side of the shaft, so as to produce exactly the same movement on the respective rods q^2 . The crank-pins q^7 extend through the slots q^3 , so that the movement of the crank is communicated to the rods q^2 and thence to the rods Q. In the operation of the machine a constant motion is given to the pulley q^5 , and consequently a constant reciprocating movement is given to the rods Q. Extending upwardly from the guides q are the brackets q^{11} and q^{12} , to which are secured the brushes L^2 and M^2 . These brushes are carried with each reciprocation of the rod Q over the plates l and m , extending with each reciprocation onto plates l^{11} and m^{11} . Extending from the brackets q^{11} q^{12} are the wires n n' . They are in electrical connection with the brushes L^2 and M^2 and insulated from the brackets referred to. They extend, as described in the diagrams, to the coils N and N'. The coils N and N' are arranged on the rods Q and reciprocate with them.

At the ends of the rods Q are formed the brackets Q' , which are provided with the bearings q^8 and q^9 . The rods R and R' are placed in these bearings, the rod R being arranged to have simply rotative movement in the bearing q^8 , but not axial movement, and the rod R' being arranged to have both axial and rotative movement in the bearing q^9 . A traveling block S is arranged on the rods R and R' and has extending through it the slot s. (See Fig. 7.) In this slot and on the shafts R and R' are arranged the sliding collars s' and s^2 . Grooves r^2 are arranged in the shafts R and R', and these form the grooves of a spline-and-groove mechanism with which the collars s' and s^2 are locked against rotative movement on the shaft R and R', but are permitted to have axial movement thereon. Extending from the collars s' and s^2 are the actuating-lugs s^3 and s^4 . These lugs are of sufficient length to protrude when the collars are turned to bring them to an upright position into the paths of the rods C and C', so that as the rods Q, and consequently the rods R and R', are reciprocated the rods C and C', which come into the paths of the lugs s^3 and s^4 , are pushed in by said lugs acting upon the ends of the rods. The normal position of the collars is such that the lugs are turned backwardly, (the lug s^3 toward the left as shown in Fig. 7,) so that they are out of the path of said rods and are only turned into the path when it is desired to make a connection. The lug s^4 is directly under the lug s^3 , so as to operate a rod C³ when a rod C² is operated and to operate a rod C⁵ when a rod C⁴ is operated.

The mechanism for throwing into position

the lugs s^3 and s^4 is as follows: An extension P' projects from the base P, on which are arranged the two uprights p^3 p^3 , which are perforated at their upper ends, thus forming a guide for a rod O'. The rod O' is provided with a collar o' , which is pressed normally against the front upright p^3 by a spring o^2 , tensioned between said collar and the rear uprights p^3 . On the end of the rod O' is an arm O², which extends into the path of the plate n^6 on the coil N. As the rod Q is carried forward in its movement the plate n^6 contacts the arm O² and moves the rod O' toward the rear of the machine, (the left in Figs. 3 and 5.) As the rod Q moves back to position the spring o^2 presses the rod back to its normal position. In the under side of the rod O' is a notch o^3 , which is shaped to be engaged by a point o^4 on a rod O³, which extends through the extension P' and upright p^3 and the coil O. The armature O⁴ is secured to the bottom of this rod and is held in place normally by the small brackets o^5 . When the buttons H² or K² are pressed, completing the circuit through the wire E¹¹, F¹¹, N², and N³, as heretofore described, energizing the coil O, it actuates the armature O⁴ and rod O³, so as to press the rod O³ upwardly and the point o^4 into engagement with the rod O' in the notch o^3 , thus locking the rod in its forward position. Extending from the front end of the rod O' are two arms O⁶ and O⁷, and these are provided with the cam-rollers o^6 and o^7 . Extending from the end of the rod R is a rock-arm n^4 , which forms an armature for the coil N. The rear part of the arm n^4 is provided with a cam-surface which engages the roller o^6 when the rod O' is locked in its inward position by the rod O³, so that when the rod O' is so locked the arm n^4 is carried back against the roller o^6 by the movement of the rod Q and down by the action of said roller against the plate n^6 , and as a circuit with a current is complete through the coil N by reason of the closure of the switch n^2 the armature forming the arm n^4 is held down through the action of the coil against the lug on the plate n^6 . An arm n^8 extends downwardly from the rod R' in the path of the roller o^7 , and the rod R' is rocked when the rod O' is held in its inward position by the action of the arm n^8 against said roller in a manner similar to the action of the arm n^4 against the roller o^6 . At the opposite end of the shaft R' there is a rock-lever n^5 , which is pressed down against a lug on the plate n^7 and forms an armature for the coils N', and these coils also being in circuit it is held in this position until the circuit is broken by the brush M¹² passing over a plate m , which is out of circuit by reason of the depression of the key or button F, connected with it, as described in relation to Fig. 2. Opposed to the force of the coils N N' are the springs r^4 , which extend from arms r^3 on the shafts R and R'. These springs extend to the tension-screws q^{10} , arranged on an arm Q², extending from

the bracket Q' at the left of the machine as viewed in Fig. 4. These tend to rock the shafts R and R' so as to bring the actuating-lugs s^3 s^4 out of the path of the rods C and C'.

5 The operation of this part of the mechanism is therefore as follows: The mechanism connected with the rods Q is constantly reciprocated by the action of the lever q^2 . The lugs s^3 and s^4 are held out of the path of the rods

10 C and C' by the action of the springs r^4 r^4 . When, however, a button K² or H² is depressed, thus energizing the coil O, the rod O', which is given a slight reciprocation with each stroke of the rod Q by reason of the contact of the

15 plate n^6 with the arm O², is locked in its inner position by the action of the rod O³ through the influence of the coil O on the armature O⁴, connected with said rod. This holds the arms O⁶ and O⁷ at their inward position, and

20 consequently the rollers o^6 and o^7 in the paths of the arms n^4 and n^8 , so that as the rod Q is brought back to its initial position the arms n^4 and n^5 are pressed down onto the lugs of the plates n^6 and n^7 , and as the coils N and N' are energized through the circuit established

25 through the brushes L² and M² the arms n^4 and n^5 are held in this position until the brushes pass over the plates l and m , which are in connection with the buttons E and F, so that the circuit of each is broken, as here-

30 inbefore described in relation to Fig. 2. This throws out the coils N and N', and the springs r^4 , acting on the arms r^3 , immediately rock the shafts or rods R and R' so as to bring the lugs s^3 and s^4 out of engagement with the rods

35 which they are actuating. The length of the rods C and C' is so proportioned with reference to the position of the lugs s^3 and s^4 and relatively to the brushes L² and M² that the brushes c are brought over the bars a and

40 b corresponding to the plates l and m just as the brushes L² and M² are brought over the corresponding plates l and m , so that when the circuit is broken the brushes c are left on the plates corresponding to the buttons E and

45 F depressed, and as the buttons E and F correspond to the wires forming the circuit of the party to be connected the circuit is completed through a wire d or d' for that party.

50 In order that the traveling block S, with the collars s^1 and s^2 , may be carried along the rods R and R', so as to engage successively the rods C and C', I have arranged the following mechanism: Notches r and r' are arranged in the

55 shafts R and R', with catch-shoulders on the sides of the notches toward the left of the machine. Spring-catches s^{11} and s^{12} are arranged to operate in these notches, the spring S² forming the spring for said catches. The notches

60 r and r' have sufficient length circumferentially of the rods to allow the catches s^{11} and s^{12} to remain in engagement during the rocking movement of the rods R and R'. Extending from the rod O' is a cam O⁵, which is arranged to bring its beveled surface in the path

65 of the end of the shaft R' when the rod O' is locked in its inward position, as heretofore

described. The end of the rod R' is rounded, so that it may more readily operate against the surface of the cam O⁵. When the rod O' 70 is locked in its inward position in forming a telephone connection and the rod R' is brought against the bevel-surface of the cam O⁵, the rod R' is moved toward the right of the machine a sufficient distance to move the 75 catch s^{11} one notch on the rod R, and as the rod R is locked against axial movement in the bearings q^8 the block S is held in this new position, thus bringing the lugs s^3 and s^4 to a new brush-rod, the distance between the 80 notches r and r' being the distance between the rods C and C'. A cone r^5 is arranged against the right end of the shaft R', so as to readily allow of its rocking movement. This cone is attached to a plate r^6 , from which extends a 85 rod r^7 . The rod r^7 extends through the ears q^{13} , arranged on the bottom of the bracket Q'. A spring r^8 is arranged to press said rod r^7 toward the left, and this, acting through the plate r^6 and cone r^5 , presses the rod R' back 90 to its normal position as soon as the shaft Q, with the rod R', has moved forward toward the rear of the machine. The cam O⁵ is so positioned that it does not actuate the rod R' except when the rod O' is locked in its inward 95 position. As the rod R' moves back to its normal position the bevel surface of the spring-catch s^{12} allows the catch to move out of the notch r' with which it has been engaged, and as the rod R' reaches its normal position 100 the catch s^{12} is pressed into the next successive notch r' . This operation, of course, is repeated with each connection. Journaled on the side of the bracket Q' at the left of the machine is a drum Q³, which is actuated by 105 a spring Q⁴. A cord Q⁵ is arranged on the outer surface of the drum and attached to the block S. The spring is tensioned to create pressure on the cords, so as to draw the block toward the left. On the outer ends of the 110 spring-catches s^{11} and s^{12} are cam-heads s^{17} and s^{18} , which are adapted to be operated upon by cams s^{15} and s^{16} . The cams s^{15} and s^{16} are carried by a rock-arm s^{14} , which is journaled on a screw-pin s^{13} , extending into the block 115 S. Extending from the rock-arm s^{14} is a contact-arm s^{15} , which is arranged in the path of a contact-post s^{21} , carried by a bracket q^{15} , extending from the arm Q² at the right of the machine and also in the path of a contact-post s^{20} , arranged on an arm q^{14} , extend- 120 ing from a bracket Q' at the left of the machine. As the block S passes the last rods C and C' at the right of the machine the arm s^{15} contacts the post s^{21} , thus pressing the 125 cams s^{15} and s^{16} under the heads s^{17} and s^{18} , thus drawing the catches s^{11} and s^{12} out of the notches r and r' . The friction of the heads holds the rock-arm s^{14} in this position, and the cord Q⁵, under tension from the spring- 130 drum Q³, immediately draws the block S back to the extreme left of the machine. When it reaches this position, the arm s^{15} contacts the post s^{20} . This throws out the cams s^{15} and

s^{16} and allows the spring-catches s^{11} and s^{12} to move inwardly into the notches r and r' , when the operation hereinbefore described may be repeated. The operation, therefore, of this part of the device relatively to the actuation of the button may be briefly described at this point, as follows: A call having been announced by the annunciator, and the keys E and F corresponding with the wires of the caller being depressed, the button K^2 is depressed. This connects the operator with the caller and at the same time energizes the coil O, setting the mechanism actuated by the rod O', locking down the rock-arm n^4 and n^5 , thus bringing the lugs s^3 and s^4 into position to operate upon a rod C^2 and a rod C^3 . These rods are pressed inwardly to the plates a and b corresponding to the wires of the caller, and thus a second connection is made by means acting with and controlled by said press-buttons. The operator then gets the number of the desired connection, releases the keys E and F and the key K^2 , thus throwing the setting mechanism controlled by the rod O' out of action, and then depresses the keys E and F corresponding to the number of the wires of the party called, at the same time depressing the button H^2 . The pressing in of the button H^2 again closes a circuit through a coil O and sets the mechanism actuated by the rod O' so as to bring the brushes of the rods C^4 and C^5 over the bars corresponding with the wires of the party called in a manner heretofore described. At the same time a connection is completed by the pressure of the button H^2 through the magneto H, thus ringing the bell of the party called. The keys E and F may then be released and the button H^2 released, and the machine is ready for a new call. The shifting mechanism of the block S automatically takes care of changing the position of the lugs s^3 and s^4 , so that this needs no attention whatever from the operator. In fact the connecting mechanism in ordinary practice is designed to operate in a different room from that containing the operating-table. It will be noted that the press-buttons E, therefore, and the mechanism immediately connected therewith form a controlling means, one for each wire, through the instrumentality of which the brushes are brought to the bars corresponding to the press-buttons actuated. As before stated, the connecting mechanism may be put in separate rooms from that in which the operating-table is placed. Where, however, the exchange is crowded and the switchboard is small for the business which is demanded of it, the board may be placed directly in front of the operator on the operating-table, so that if all the rods carrying the brushes have been utilized before the parties utilizing the first pair of rods in the series have completed their conversation the operator may shift the block S past the rods which are being utilized for the circuits on which the conversations are not completed to some rod which is out of use.

This can be readily accomplished, because the catches s^{11} s^{12} are beveled, so as to allow the ready movement of the block in a forward direction. This movement of the block, of course, should take place just at the moment of time when the reciprocating frame including the rods R R' are at their extreme outer position, so that there may be no danger of the small catches d^6 and s^7 operating upon the lugs C^6 on the rods as the block is being moved.

In order that the rods C' and C may be brought back to their normal position in advance of the movement of the lugs s^3 and s^4 , I provide the following mechanism: Extending from the block S is an arm S', at the end of which is a carrier s^5 . Arranged in the carrier are two spring-catches s^6 and s^7 , having bevel-surfaces s^8 and s^9 , extending toward the rear of the machine. A spring s^{10} presses said catches apart. On the under sides of the rods C and the upper sides of the rods C' are arranged the pins C^6 . The catches s^6 and s^7 are arranged in advance of the lugs s^3 and s^4 , so that as two rods, as C^2 and C^3 , are pushed in by the operation of the lugs s^3 and s^4 the next succeeding rods C^4 and C^5 are engaged with the outward movement of the block S by the catches s^6 and s^7 and drawn to their outer position. At this point, if at the next reciprocation a connection has been arranged for, the block S is shifted to the next rod, the spring-catches being of just sufficient length when at their extreme outer position to pass freely between the rods C and C'. If the rod next succeeding the one pushed in has been previously pushed in, (and this should be invariably the case,) the bevel-surfaces s^8 s^9 , coming into contact with the pins C^6 , actuate the spring-catches, so as to allow passage by said pins. By this mechanism the rods forming the connection between the phones are left in circuit as long as the capacity of the machine will permit, or, in other words, in the ordinary operation the parties connected through the first rods at the left will be left in connection if they have not themselves rung off until the block S has moved entirely across the machine and utilized every other rod C C' in the series.

In Fig. 8 the details of the automatic switch mechanism shown in Fig. 1 are illustrated. Herein are shown the coils D d^4 , the wires d and d' operating as described in relation to said figure, the wire d and d' being connected through usual buttons extended through usual posts d^7 d^7 . The armature d^3 is pivoted on a frame D', and has at its outer end a counterweight D⁴, by the adjustment of which the armature d^3 is so balanced as to remain in any position in which it is placed. Arranged on the armature d^3 are two contact-plates D² and D³, insulated from each other and connected to the wires d and d' , respectively. Two posts d^8 and d^9 are connected with the wires d and d' , respectively, and arranged in the path of the blocks D² and D³, respectively.

Previous to the utilization of the wires d and d' , passing through each of the coils D , the operator presses down on the weight D^4 , throwing the switch d^2 into circuit. When the party rings off, the armature d^3 is attracted, as hereinbefore described, thus breaking the connection through the switch. The throwing in of this switch, while described as being done by the operator, may be accomplished automatically; but I have not shown mechanism for that purpose.

While in the claims the term "brushes arranged to pass over the bars" is used, it must be understood that this is not intended to limit the device to one in which there is an actual movement of the brushes, but to describe a movement of the parts which would cause the brushes to pass by the bars. It must also be understood that the bars a and b , with which the line-wires are connected, are, in effect, brushes which operate upon the parts or brushes c and that the part C might be termed the "bars." In the claims, therefore, I do not wish to be understood by the term "brushes and bars" to describe a peculiar shape of instrument; but I use this term both in the specification and in the claims rather for convenience to distinguish one set of cross-acting members of the connecting mechanism from the other. To this end I wish it to be understood that the arrangement and shape of the members may be reversed without affecting their identity with my invention.

What I claim as new is—

1. In a telephone-exchange, the combination of a series of incoming line-wires; a series of outgoing line-wires; a set of brushes; a set of bars, one of said sets being connected with the line-wires and having the members of the set connected with the outgoing line-wires, arranged in a separate group from those connected with the incoming line-wires, and the members of the other set being connected in pairs, one of each pair being adapted to pass across the members of the other set into contact with any member of said set, said members being normally out of connection with said line-wires; and electric connections between said pairs of members arranged to form telephonic connections between two pairs of any of said line-wires by the passing of two pairs of connecting members into contact with the members of the other set connected with said line-wires.

2. In a telephone-exchange mechanism, the combination of a series of outgoing line-wires; a series of incoming line-wires; a series of bars for each, the bars for each series of line-wires being arranged in a separate group; brushes arranged to pass across each of said series of bars to the bars connected with the line-wires of the parties to be connected; and means for forming a telephonic connection through said brushes between said bars and consequently between the lines to be connected.

3. In a telephone-exchange mechanism, the combination of outgoing and incoming line-wires, a series of bars for said wires, those for the incoming and outgoing wires being arranged in separate groups, said bars being insulated from each other; a series of brushes arranged to pass across said bars to the bars connected with the line-wires of the parties to be connected, said brushes being arranged in twos, each pair to form a connection between the bars connected with the lines of the parties to be connected; and means for forming a telephonic connection through each pair of said brushes between the bars to be connected and consequently between the lines to be connected.

4. In a telephone-exchange mechanism, the combination of a series of outgoing line-wires, and a series of incoming line-wires; a series of bars for each of said series of wires; a series of brushes arranged to pass across each series of bars to the bars connected with the lines to be connected, said brushes being arranged in pairs, each pair to form one telephonic connection; and means for forming a telephonic connection through said brushes between said bars, and consequently between the lines to be connected.

5. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; a series of brushes arranged to pass across said bars to the bars connected with the line-wires of the parties to be connected, and said series of brushes arranged in pairs each brush being arranged next in succession to its companion brush; and means for forming a telephonic connection through said brushes between the bars to be connected and between the brushes of each pair.

6. In a telephone-exchange, the combination of a series of incoming line-wires; a series of outgoing line-wires; a set of brushes; a set of bars, one of said sets being connected with the line-wires and having the members of the set connected with the outgoing line-wires in a group separate from those connected with the incoming line-wires, and the other of said sets being arranged in pairs in telephonic connection; and means for bringing a pair of the telephonically-connected members into contact with the members of the other set connected with the line-wires of the parties to be connected.

7. In a telephone-exchange mechanism, the combination of a series of outgoing and a series of incoming line-wires; a series of bars for each series of wires; each series arranged in separate groups; brushes electrically connected in pairs, one of each pair adapted to pass across one of said series of bars to be brought into contact with any of the bars of said series, said brushes being normally out of connection with the line-wires; an electric connection between said brushes arranged to form telephonic connections between two pairs of line-wires by the movement of two

pairs of brushes into contact with the bars connected with said line-wires.

8. In a telephone-exchange mechanism, the combination of an inductive repeater, normally out of the line-circuits; a system of line-wires comprising a series of outgoing wires and a series of incoming wires; and means for connecting each circuit of the repeater with any one outgoing wire and any one incoming wire.

9. In a telephone-exchange mechanism, the combination of a series of outgoing and incoming line-wires; a series of bars for each series of line-wires; said series of bars being arranged in separate groups; brushes arranged to pass across said bars of both series to the bars connected with the line-wires of the parties to be connected; an inductive repeater; and wires connecting the circuit of said repeater with said brushes.

10. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; outgoing and incoming line-wires connected with said bars; the bars connected with the outgoing wires being arranged in a separate group from those connected with the incoming wires; a series of brushes arranged to pass across said bars to the bars connected with the line-wires of the parties to be connected; and a series of inductive repeaters, each connected with a pair of brushes of said series of brushes, one of the brushes of each pair being connected with one circuit of the repeater.

11. In a telephone-exchange mechanism, the combination of a series of incoming line-wires; an outgoing line-wire for the opposite sides of the telephone-circuit; a series of telephones one connected with each incoming wire and all in common connected with the outgoing wire; a series of bars connected with the incoming wires; brushes arranged to pass over said bars to the bars connected with the incoming wires of the parties to be connected; and means for forming a telephonic connection through said brushes between said bars and said outgoing wire.

12. In a telephone-exchange mechanism, the combination of a series of incoming wires; an outgoing wire for the opposite sides of the circuit; a series of telephones, one connected with each incoming wire and all in common connected with the outgoing wires; a series of bars connected with the incoming wires; a series of pairs of brushes arranged to pass across said bars, each of a pair to the bars connected with the line-wires of two parties to be connected; and means for forming a telephonic connection through each pair of brushes between said bars and the outgoing wire.

13. In a telephone-exchange mechanism, the combination of a series of incoming line-wires; an outgoing line-wire for the opposite sides of the circuit; a series of telephones, one connected with each incoming wire and

all in common connected with the outgoing wire; a series of bars connected with said incoming wires; brushes electrically connected in pairs, one of each pair adapted to pass across said series of bars and to be brought into contact with any of the bars of said series, and the other to be connected with said outgoing wire; and electric connections between said brushes arranged to form telephonic connection between two pairs of brushes by the passing of two pairs of brushes into contact with the bars connected with said incoming and outgoing wires.

14. In a telephone-exchange mechanism, the combination of a series of incoming line-wires; an outgoing line-wire for the opposite sides of the circuits; a series of telephones, one connected with each incoming wire and all connected in common with the outgoing wire; an inductive repeater normally out of the line-circuits; and means for connecting the circuits through the repeater with said outgoing wire with any of the incoming wires.

15. In a telephone-exchange mechanism, the combination of a series of incoming line-wires; an outgoing line-wire for the opposite sides of the circuits; a series of telephones one connected with each incoming wire and all in common connected with the outgoing wire; a series of bars connected with said incoming wires; brushes arranged to pass across said bars to the bars connected with the lines of the parties to be connected; an inductive repeater having one side of each of its circuits connected with one of said brushes, and the other connected with the outgoing wire.

16. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire with one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; a series of bars connected with the outgoing wires and a series of bars connected with the incoming wires; brushes arranged to pass across said bars to the bars connected with the line-wires of the parties to be connected; and means for forming telephonic connection through said brushes between said bars.

17. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire of one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; a series of bars connected with the outgoing wires and a series of bars connected with the incoming wires; a series of brushes arranged in pairs and adapted to pass across said bars to the bars connected with the lines of the par-

ties to be connected; and means for forming a telephonic connection through the brushes of each pair between said bars.

18. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire with one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; a series of bars connected with the outgoing wires and a series of bars connected with the incoming wires; an inductive repeater normally out of the line-circuits; and means for connecting the two circuits of said repeater with any of the circuits formed by the outgoing and incoming wires.

19. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire with one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; a series of inductive repeaters normally out of the line-circuits; means for connecting any of the repeaters with any of the circuits formed by the incoming and outgoing wires.

20. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire with one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; a series of bars connected with each of said series of wires; brushes arranged to pass across said bars to the bars connected with the line-wires of the parties to be connected; and an inductive repeater having its circuits connected with said brushes.

21. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire with one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; a series of bars connected with each series of wires; a series of brushes arranged in pairs adapted to pass across said bars to the line-wires of a party to be connected; and a series of inductive repeaters each having each of its circuits connected with a pair of said brushes.

22. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire of one of the se-

ries of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; a switch for disconnecting a telephonic connection formed in said circuit; a magneto; and means actuated by the disturbance created in said circuit by the said magneto for operating said switch to open said circuit, and cut the connection.

23. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; brushes arranged to move across said bars to the bars connected with the line-wires of the parties to be connected; means for forming a telephonic connection through said brushes between said bars; a switch arranged in a circuit forming said connection; a magneto; and means actuated by the said magneto in the said circuit for actuating said switch for opening the circuit, and to cut the connection.

24. In a telephone-exchange mechanism, the combination of a series of incoming line-wires; an outgoing line-wire for the opposite side of the circuit; a series of telephones, one connected with each incoming line-wire for the opposite side of the circuit; a series of telephones one connected with each incoming wire, and all in common connected with the outgoing wire; a double coil normally out of the line-circuit; means for connecting each of said circuits with said outgoing and any of the incoming wires; a switch arranged in one of said circuits; a magneto; and means actuated by a magneto disturbance in a circuit in telephonic connection with said circuit for actuating said switch.

25. In a telephone-exchange mechanism, the combination of a series of outgoing line-wires; a series of groups of telephones connected with said wires each group utilizing in common one wire of one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; a double coil normally out of the line-circuits; means for connecting the circuits through the coil with the circuits formed by the outgoing and incoming wires; a switch arranged in a circuit in telephonic connection with said circuit; a magneto, means actuated by the said magneto in one of the telephone-circuits for actuating said switch.

26. In a telephone-exchange mechanism, the combination of a series of incoming line-wires; an outgoing line-wire for the opposite sides of the circuit; a series of telephones one connected with each incoming wire and all connected in common with the outgoing wire; and a condenser arranged in connection with a wire of said system which is adjacent to and of smaller capacity than another wire of said system for equalizing the capacity of said wires whereby the tendency to induction

from one wire to the other by reason of the difference in capacity is obviated.

27. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires each group utilizing in common one wire of one of the series of wires for one side of their circuits; and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; and a condenser connected and arranged on a wire of one of said series for equalizing the capacity of said wires.

28. In a telephone-exchange mechanism, the combination of a series of incoming line-wires and an outgoing line-wire; a common or exchange telephone-circuit; switches for connecting each of the incoming wires with one side of said exchange-circuit; press-buttons for directly operating said switches; and means for connecting the outgoing wires with the other side of said circuit.

29. In a telephone-exchange mechanism, the combination of a series of incoming line-wires and an outgoing line-wire; means for connecting each of the incoming wires with one side of a common or exchange telephone-circuit; means for connecting the outgoing wire with the other side of said circuit; means acting with said connecting means for forming a second connection including the incoming wire connected with the exchange-circuit and the outgoing wire.

30. In a telephone-exchange mechanism, the combination of a series of incoming line-wires and an outgoing line-wire; means for connecting each of the incoming wires with one side of a common or exchange telephone-circuit; means for connecting the outgoing wire with the other side of said circuit; and means controlled by said connecting means for forming a second connection including the incoming wire connected with the exchange-circuit and the outgoing wire.

31. In a telephone-exchange mechanism, the combination of a series of incoming line-wires and an outgoing line-wire; means for connecting each of the incoming wires with one side of a common or exchange telephone-circuit; means for connecting the outgoing wire with the other side of said circuit; and means controlled by said connecting means for simultaneously forming a second connection including the incoming wire connected with the exchange-circuit and the outgoing wire.

32. In a telephone-exchange mechanism, the combination of a series of incoming line-wires and an outgoing line-wire; means for connecting each of the incoming wires with one side of a common or exchange telephone-circuit; means for connecting the outgoing wire with the other side of said circuit; mechanism acting with said means for forming a second connection including the incoming wire connected with the exchange-circuit and

the outgoing wire; and means controlling said mechanism for actuating it to connect the exchange-telephone alone, and the exchange-telephone and the second connection simultaneously and also said connections successively.

33. In a telephone-exchange mechanism, the combination of a series of incoming line-wires and an outgoing line-wire; press-buttons for connecting each of the incoming wires with one side of a magneto-circuit; said magneto-circuit; and means for connecting the outgoing wire with the other side of the magneto-circuit to complete a circuit through the magneto independent of any other circuit between any incoming wire and the outgoing wire.

34. In a telephone-exchange mechanism, the combination of a series of line-wires; a magneto-circuit; switches for connecting the line-wires to said magneto-circuit; press-buttons for operating said switches; a second circuit; and means controlled by said switches for connecting said line-wires with said second circuit.

35. In a telephone-exchange mechanism, the combination of a series of line-wires; press-buttons for completing a circuit between the line-wires through a magneto; mechanism acting with said press-buttons for forming a second connection including said line-wires; and means for controlling said mechanism for turning in the magneto alone and for turning in the magneto and forming a second connection simultaneously and also for turning in the magneto and forming a second connection successively.

36. In a telephone-exchange mechanism, the combination of a series of outgoing and incoming line-wires; a series of groups of telephones connected with said wires each group utilizing in common one wire of one of the series of wires for one side of their circuits and a different wire of the other series for each telephone of the group, each series containing a common wire for a group; means for connecting each of the outgoing wires with one side of the common or exchange telephone-circuit; and means for connecting each of the incoming wires with the other side of said circuit both by direct electrical connection.

37. In a telephone-exchange mechanism, the combination of a series of outgoing and incoming line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire of one of the series of wires for one side of their circuits and a different wire of the other series for each telephone of the group, each series containing a common wire for a group; a press-button for each incoming and outgoing wire; and means actuated by said press-buttons for connecting its line-wire with a common telephone-circuit.

38. In a telephone-exchange mechanism, the combination of a series of outgoing and in-

coming line-wires; a series of groups of tele-
phones connected with said wires each group
utilizing in common one wire of one of the
series of wires for one side of their circuits,
5 and a different wire of the other series for
each telephone of the group, each series con-
taining a common wire for a group; means
for connecting each of the outgoing wires
with one side of the common or exchange tele-
10 phone-circuit; means for connecting each of
the incoming wires with the other side of said
circuit; and mechanism acting with said con-
necting means for forming a second connec-
tion including the line-wires connected with
15 the telephone-circuit.

39. In a telephone-exchange mechanism,
the combination of a series of outgoing and in-
coming line-wires; a series of groups of tele-
phones connected with said wires each group
20 utilizing in common one wire of one of the se-
ries of wires for one side of their circuits and
a different wire of the other series for each
telephone of the group each series containing
a common wire for a group; means for con-
25 necting each of the outgoing wires with one
side of the common or exchange telephone-
circuit; means for connecting each of the in-
coming wires with the other side of said cir-
cuit; and mechanism controlled by said con-
30 necting means for forming a second connec-
tion including the line-wires connected with
the telephone-circuit.

40. In a telephone-exchange mechanism,
the combination of a series of outgoing and in-
35 coming line-wires; a series of groups of tele-
phones connected with said wires, each group
utilizing in common one wire of one of the se-
ries of wires for one side of their circuits and
a different wire of the other series for each
40 telephone of the group, each series contain-
ing a common wire for a group; a press-but-
ton for each incoming and outgoing wire;
means actuated by said press-buttons for con-
necting its line-wire with a common telephone-
45 circuit; and mechanism controlled by said
buttons for forming a second connection in-
cluding the line-wires connected with the ex-
change-circuit by said buttons.

41. In a telephone-exchange mechanism,
50 the combination of a series of outgoing and in-
coming line-wires; a series of groups of tele-
phones connected with said wires each group
utilizing in common one wire of one of the se-
ries of wires for one side of their circuits and
55 a different wire of the other series for each
telephone of the group, each series contain-
ing a common wire for a group; means for
connecting each of the outgoing wires with
one side of the common or exchange telephone-
60 circuit; means for connecting each of the in-
coming wires with the other side of said cir-
cuit; and mechanism controlled by said con-
necting means for simultaneously forming a
second connection including the line-wires
65 connected with the telephone-circuit.

42. In a telephone-exchange mechanism,
the combination of a series of outgoing and in-

coming line-wires; a series of groups of tele-
phones connected with said wires each group
utilizing in common one wire of one of the se- 70
ries of wires for one side of their circuits and
a different wire of the other series for each
telephone of the group each series containing
a common wire for a group; means for connect-
ing each of the outgoing wires with one side of 75
the common or exchange telephone-circuit;
means for connecting each of the incoming
wires with the other side of said circuit; mech-
anism acting with said connecting means for
forming a second connection including the 80
line-wires connected with the telephone-cir-
cuit; and means for controlling said mech-
anism to connect the exchange-circuit alone,
the exchange-circuit and the second connec- 85
tion simultaneously, or the exchange-circuit
and the second connection successively at
will.

43. In a telephone-exchange mechanism,
the combination of a series of outgoing and in-
coming line-wires; a series of groups of tele- 90
phones connected with said wires, each group
utilizing in common one wire of one of the
series of wires for one side of their circuits
and a different wire of the other series for
each telephone of the group, each series con- 95
taining a common wire for a group; a press-
button for each wire; and mechanism actu-
ated by each of said press-buttons to connect
its line-wire with a magneto-circuit.

44. In a telephone-exchange mechanism, 100
the combination of a series of outgoing and in-
coming line-wires; a series of groups of tele-
phones connected with said wires each group
utilizing in common one wire of one of the
series of wires for one side of their circuits 105
and a different wire of the other series for
each telephone of the group each series con-
taining a common wire for a group; means
for connecting each of the outgoing wires with
a magneto-circuit and each of the incoming 110
wires with the other side of said circuit; and
mechanism acting with said connecting means
for forming a second connection including
the line-wires connected with the magneto-
circuit. 115

45. In a telephone-exchange mechanism,
the combination of a series of outgoing and in-
coming line-wires; a series of groups of tele-
phones connected with said wires each group
utilizing in common one wire of one of the 120
series of wires for one side of their circuits
and a different wire of the other series for
each telephone of the group, each series con-
taining a common wire for a group; means
for connecting each of the outgoing wires with 125
a magneto-circuit; and each of the incoming
wires with the other side of said circuit; and
mechanism acting with said connecting means
for simultaneously forming a second connec-
tion including the line-wires connected with 130
the magneto-circuit.

46. In a telephone-exchange mechanism,
the combination of a series of outgoing and in-
coming line-wires; a series of groups of tele-

phones connected with said wires each group utilizing in common one wire of one of the series of wires for one side of their circuits and a different wire of the other series for each telephone of the group, each series containing a common wire for a group; means for connecting each of the outgoing wires with a magneto-circuit and each of the incoming wires with the other side of said circuit; mechanism acting with said connecting means for forming a second connection including the line-wires connected with the magneto-circuit; and means for connecting the magneto-circuit alone with the said line-wires or simultaneously or successively forming said magneto-circuit and second connection.

47. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; brushes arranged to pass across said bars to the bars connected with the line-wires of the parties to be connected; means for forming a telephonic connection through the brushes between said bars; controlling mechanism one for each line-wire; means controlled by said mechanism for passing the brushes to the bars connected with the line-wires corresponding to the controlling mechanism actuated.

48. In a telephone-exchange mechanism, the combination of a series of outgoing line-wires; a series of incoming line-wires; a series of bars for each; brushes arranged to pass across each of said series of bars to the bars connected with the line-wires of the parties to be connected; means for forming a telephonic connection passing through said brushes between said bars and consequently between the lines to be connected; a series of controlling mechanism one for each line-wire; and means controlled by said mechanisms for passing said brushes to connect with the bars corresponding to the controlling mechanisms actuated.

49. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; a series of brushes arranged to pass across said bars to the bars connected with the line-wires of the parties to be connected, said brushes being arranged in twos, each pair to form a connection; means for forming a telephonic connection passing through each pair of said brushes between the bars to be connected and consequently between the lines to be connected; controlling mechanism for each of said wires; and means controlled by said controlling mechanism for passing said brushes in pairs successively into contact with the bars corresponding to the controlling mechanisms actuated.

50. In a telephone-exchange mechanism, the combination of a series of outgoing and a series of incoming line-wires; a series of bars for each series of wires; brushes electrically connected in pairs, each pair adapted to pass across one of said series of bars to be

brought into contact with any of the bars of said series; an electric connection between said brushes arranged to form telephonic connections between two pairs of line-wires by the passing of two pairs of brushes into contact with the bars connected with said line-wires; controlling mechanism for each of said wires; and means controlled by said controlling mechanisms for passing said brushes in pairs successively into contact with the bars corresponding to the controlling mechanisms actuated.

51. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; brushes arranged to move across said bars to the bars connected with the line-wires of the parties to be connected; means for forming a telephonic connection passing through said brushes between said bars, and consequently between the lines to be connected; an exchange telephone-circuit; a series of controlling mechanisms one for each line-wire; means controlled by said mechanisms for simultaneously connecting the exchange-phone with the line-wires corresponding to said mechanisms, and to move said brushes to the bars corresponding to said mechanisms.

52. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; brushes arranged to pass across said bars to the bars connected with the line-wires of the parties to be connected; means for forming a telephonic connection through the brushes between said bars; an electrically-actuated controlling mechanism one for each line-wire; and means controlled by said mechanisms for passing the brushes to the bars connected with the line-wires corresponding to the controlling mechanism actuated.

53. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; a series of brushes arranged to pass across said bars to the bars connected with the line-wires of the parties to be connected, said brushes being arranged in twos, a pair to a connection; means for forming a telephonic connection passing through each pair of said brushes between the bars to be connected and consequently between the lines to be connected; electrically-actuated controlling mechanism for each of said wires; and means controlled by said controlling mechanism for passing said brushes in pairs successively into contact with the bars corresponding to the controlling mechanisms actuated.

54. In a telephone-exchange mechanism, the combination of an inductive repeater normally out of the line-circuits; a series of telephone-circuits; means for connecting any two of them with said repeater, one with each side of said repeater; controlling mechanism

for each telephone-circuit; and means controlled by said mechanisms for automatically connecting said telephone-circuits with said repeater-circuits.

5 55. In a telephone-exchange mechanism, the combination of a series of inductive repeaters normally out of the line-circuits; a series of telephone-circuits; means for connecting any two of them with any of said repeaters, one with each circuit of said repeater; a series of controlling mechanisms one for each circuit; and means controlled by said mechanisms for connecting said circuits with said repeaters successively.

15 56. In a telephone-exchange mechanism, the combination of an inductive repeater normally out of the line-circuits; a system of line-wires; means for connecting any two of the lines of said line-wires in said system with each circuit through said repeater; a controlling mechanism for each line wire; and means controlled by said mechanism for actuating said connecting means to connect the line-wire, corresponding with the actuated controlling mechanism, with said repeater.

25 57. In a telephone-exchange mechanism, the combination of an inductive repeater normally out of the line-circuits; a series of telephone-circuits; means for connecting any two of them with said repeater, one with each repeater-circuit; electrically-actuated controlling mechanism for each telephone-circuit; and means controlled by said mechanism for actuating said connecting means to connect said telephone-circuits with said repeater-circuits.

35 58. In a telephone-exchange mechanism, the combination of an inductive repeater normally out of the line-circuits; a series of telephone-circuits; means for connecting any two of them with said repeater, one with each repeater-circuit; an exchange telephone-circuit; controlling mechanism for each telephone-circuit; and means controlled by said controlling mechanism for connecting said exchange telephone-circuit with the line-circuits and for actuating said connecting means to connect the line-circuits with the repeater-circuits.

40 59. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms; a reciprocating means; a mechanism for setting said reciprocating means to act upon said connecting mechanisms successively.

55 60. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms; a reciprocating means; mechanism for setting said means to act upon said connecting mechanisms throughout the series; and means for controlling said setting mechanism to bring it in a position to act upon the initial connecting mechanism after the completion of the series.

60 61. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms; a constantly-reciprocating

means; and mechanism for setting said reciprocating means to act upon said connecting mechanisms successively.

70 62. In a telephone-exchange mechanism the combination of a series of connecting mechanisms arranged in pairs; a telephone connection between said pairs; and a reciprocating mechanism arranged to act successively upon the connecting mechanisms of each pair.

75 63. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms arranged in pairs; a telephone connection between said pairs; a constantly-reciprocating mechanism arranged to act successively upon the connecting mechanisms of each pair.

80 64. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms arranged in pairs; a series of inductive repeaters, one circuit of each being connected with one of the mechanisms of each pair of connecting mechanisms; and a reciprocating mechanism for actuating said connecting mechanism to form a connection.

85 65. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms arranged in pairs; a series of inductive repeaters, one circuit of each being connected with one of the mechanisms of each pair of connecting mechanisms; and a reciprocating mechanism acting upon said connecting mechanisms successively.

90 66. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms; a reciprocating means; an electrically-controlled mechanism for setting said reciprocating means to act upon said connecting mechanisms successively.

95 67. In a telephone-exchange mechanism, the combination of contacts connected with telephone-circuits; a brush adapted to be moved across said contacts and to contact therewith; a constantly-reciprocating means; a controlling mechanism for coupling and uncoupling said brushes with and from said reciprocating means.

100 68. In a telephone-exchange mechanism, the combination of contacts connected with telephone-circuits; a brush adapted to be moved across said contacts and to contact therewith; a constantly-reciprocating means; a controlling mechanism, one for each contact; means controlled by said mechanism for coupling said brushes with said reciprocating means and uncoupling said brushes from said reciprocating means on the contact corresponding to the controlling mechanism actuated.

105 69. In a telephone-exchange mechanism, the combination of contacts connected with telephone-circuits; a brush adapted to be moved across said contacts and to contact therewith; a constantly-reciprocating means; a controlling mechanism, one for each contact; means controlled by said mechanism for coupling said brushes with said reciprocating means.

ating means and uncoupling said brushes from said reciprocating means on the contact corresponding to the controlling mechanism actuated; an exchange telephone-circuit; and means actuated by the controlling mechanism for connecting said circuit with the circuits corresponding to the actuated mechanism.

70. In a telephone-exchange mechanism, the combination of contacts connected with telephone-circuits; a brush adapted to be moved across said contacts and to contact therewith; a constantly-reciprocating means; a controlling mechanism, one for each contact; means controlled by said mechanism, for coupling said brushes with said reciprocating means and uncoupling said brushes from said reciprocating means on the contact corresponding to the controlling mechanism actuated; a magneto-circuit; and means actuated by the controlling mechanism for connecting said circuit with the circuits corresponding to the actuated mechanism.

71. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; brushes arranged to move across said bars to the bars connected with the line-wires of the parties to be connected; means for forming a telephonic connection through said brushes between said bars, and consequently between the lines to be connected; a reciprocating mechanism having at each reciprocation a movement sufficient to move said brush by the bar to be connected; and means for coupling said reciprocating mechanism with said brushes to move them over said bars and for uncoupling said brushes in position on said bars.

72. In a telephone-exchange mechanism, the combination of series of bars insulated from each other; line-wires connected with said bars; a series of brushes arranged to move across said bars to the bars connected with the line-wires of the parties to be connected, said brushes being arranged in twos, each pair to form a connection; means for forming a telephonic connection through each pair of said brushes between the bars to be connected and consequently between the lines to be connected; a reciprocating mechanism having at each reciprocation a movement sufficient to move said brush by the bar to be connected; and means for coupling said brushes and said reciprocating mechanism in pairs to carry said brushes over said contact and to uncouple said brushes in position on said bars.

73. In a telephone-exchange mechanism, the combination of a series of outgoing and a series of incoming line-wires; a series of bars for each series of wires; brushes electrically connected in pairs, one of each pair adapted to be moved across one of said series of bars to be brought into contact with any of the bars of said series; an electric connection between said brush couple arranged to form telephonic connections between two

pairs of line-wires by the movement of two pairs of brushes into contact with the bars connected with said line-wires; a reciprocating mechanism; means for coupling said brushes and said reciprocating mechanism in pairs to carry said brushes over said contact and to uncouple said brushes in position on said bars.

74. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; brushes arranged to move across said bars to the bars connected with the line-wires of the parties to be connected; means for forming a telephonic connection through said brushes between said bars, and consequently between the lines to be connected; a constantly-reciprocating mechanism; means for coupling said reciprocating mechanism with said brushes to move them over said bars and for uncoupling said brushes in position on said bars.

75. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; brushes arranged to move across said bars to the bars connected with line-wires of the parties to be connected; an inductive repeater; a connection between said brushes and said repeater; a reciprocating mechanism; a controlling mechanism; and means controlled by said controlling mechanism for coupling and uncoupling said reciprocating mechanism with and from said brushes.

76. In a telephone-exchange mechanism, the combination of a series of bars insulated from each other; line-wires connected with said bars; a series of brushes arranged to move across said bars to the bars connected with the line-wires of the parties to be connected; a series of double coils, each connected with a pair of brushes of said series of brushes, one of the brushes of each pair being connected with one circuit of the coil, and the other brush with the other coil-circuit; a reciprocating mechanism; a mechanism for coupling and uncoupling said reciprocating mechanism; and means controlled by said reciprocating mechanism with and from said brushes successively for successive connections.

77. In a telephone-exchange mechanism, the combination of a series of incoming line-wires; an outgoing line-wire forming the opposite sides of the telephone-circuits; a series of telephones one connected with each incoming wire and all in common connected with the outgoing wire; a series of bars connected with the incoming wires; brushes arranged to move over said bars to the bars connected with the incoming wires of the parties to be connected; means for forming a telephonic connection through said brushes between said bars and said outgoing wire; a reciprocating mechanism, having at each reciprocation movement sufficient to move a brush by the bar to be connected; a controlling mechanism

ism; and means controlled by said controlling mechanism for coupling and uncoupling said reciprocating mechanism with and from said brushes.

5 78. In a telephone-exchange mechanism, the combination of a series of incoming line-wires; an outgoing line-wire for the opposite sides of the telephone-circuit; a series of tele-
10 phones one connected with each incoming wire and all in common connected with the outgoing wire; a series of bars connected with the incoming wires; brushes arranged to move over said bars to the bars connected with the incoming wires of the parties to be con-
15 nected; means for forming a telephonic connection through said brushes between said bars and said outgoing wire; a constantly-reciprocating mechanism; a controlling mechanism; and means controlled by said control-
20 ling mechanism for coupling and uncoupling said reciprocating mechanism with and from said brushes.

79. In a telephone-exchange mechanism, the combination of a series of incoming line-
25 wires; an outgoing line-wire for the opposite sides of the circuits; a series of telephones one connected with each incoming wire and all in common connected with the outgoing wire; a series of bars connected with said in-
30 coming wires; brushes arranged to independently move across said bars to the bars connected with the lines of the parties to be connected; a double coil having one side of each of its circuits connected with one of said
35 brushes, and the other connected with the outgoing wire; a reciprocating mechanism; and means for coupling and uncoupling said reciprocating mechanism from said brushes.

80. In a telephone-exchange mechanism,
40 the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires each group utilizing in common one wire of one of the series of wires for one side of their circuits,
45 and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group; a series of bars connected with the outgoing wires and a series of bars connected with the
50 incoming wires; brushes arranged to move across said bars to the bars connected with the line-wires of the parties to be connected; means for forming telephonic connection through said brushes between said bars; a
55 reciprocating mechanism; and means for coupling and uncoupling said brushes from said reciprocating mechanism.

81. In a telephone-exchange mechanism, the combination of a series of incoming and
60 outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire of one of the series of wires for one side of their circuits, and a different wire of the other series for
65 each telephone of the group, each series of wires containing a common wire for a group;

a series of bars connected with the outgoing wires and a series of bars connected with the incoming wires; an inductive repeater nor-
70 mally out of the line of circuits; means for connecting the two circuits of said coil with any of the circuits formed by the outgoing and incoming wires; a reciprocating mechanism; and means for coupling and uncoupling
75 said brushes from said reciprocating mechanism.

82. In a telephone-exchange mechanism, the combination of a series of incoming line-wires; an outgoing line-wire for the opposite sides of the telephone-circuit; a series of tele-
80 phones one connected with each incoming wire and all in common connected with the outgoing wire; a series of bars connected with the incoming wires; brushes arranged to move over said bars to the bars connected with the
85 incoming wires of the parties to be connected; means for forming a telephonic connection through said brushes between said bars and said outgoing wire; a reciprocating mechanism having at each reciprocation sufficient
90 movement to move a brush by the bar to be connected; a controlling mechanism for each incoming line-wire; and means controlled by said controlling mechanism for coupling said
95 brushes with said reciprocating means, and uncoupling said brushes from said reciprocating means on the bar corresponding to the controlling mechanism.

83. In a telephone-exchange mechanism, the combination of a series of incoming and
100 outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire of one of the series of wires for one side of their circuits, and a different wire of the other series for
105 each telephone of the group, each series of wires containing a common wire for a group; a series of bars connected with the outgoing wires and a series of bars connected with the incoming wires; brushes arranged to move
110 across said bars to the bars connected with the line-wires of the parties to be connected; means for forming telephonic connection through said brushes between said bars; a reciprocating mechanism; a controlling mech-
115 anism, one for each line-wire and connected bar; and means controlled by said controlling mechanism for coupling said brushes with said reciprocating means and for uncoupling said brushes from said reciprocating means
120 with the brush of the bar corresponding to the actuated controlling mechanism.

84. In a telephone-exchange mechanism, the combination of a series of incoming and
125 outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire of one of the series of wires for one side of their circuits, and a different wire of the other series for
130 each telephone of the group, each series of wires containing a common wire for a group; a series of bars connected with the outgoing

wires and a series of bars connected with the incoming wires; an inductive repeater normally out of the line of circuit; means for connecting the two circuits of said coil with any of the circuits formed by the outgoing and incoming wires; a reciprocating mechanism; a controlling mechanism one for each line-wire and connected bar; and means controlled by said controlling mechanism for coupling said brushes with said reciprocating means and for uncoupling said brushes from said reciprocating means with the brush of the bar corresponding to the actuated controlling mechanism.

85. In a telephone-exchange mechanism, the combination of a series of outgoing line-wires; a series of incoming line-wires; a series of bars connected with said line-wires; a series of press-buttons one for each line-wire; a brush arranged to move across said bars into contact with any of said bars; a telephone-circuit connected with said brush; a controlling-wire leading from each of said buttons and thrown into and out of circuit with an electric power-producing element by the action of said button; a constantly-reciprocating means; and means controlled by the energy conveyed through the wire leading from said button for actuating said reciprocating mechanism to uncouple it from the brush with the brush over the bar corresponding with the button actuated.

86. In a telephone-exchange mechanism, the combination with the series of line-wires; a series of buttons one for each of said wires; a series of bars one for each of said wires; a brush arranged to move across said bars into contact with any of said bars; a reciprocating means having at each reciprocation movement sufficient to move a brush by the bar to be connected; means for setting the reciprocating means to couple with said brush; and means controlled by said buttons for actuating said reciprocating means to uncouple from said brush with the brush over the bar corresponding to the button actuated.

87. In a telephone-exchange mechanism, the combination with the line-wires; of a series of buttons, E, connected with said line-wires; a telephone-exchange circuit-wire, e^4 ; means connected by the action of said buttons, E, for connecting each line-wire with the exchange-wire, e^4 ; and means controlled by said buttons for forming a connection with said line-wires.

88. In a telephone-exchange mechanism, the combination with the line-wires; of a series of buttons, E, connected with said line-wires; a telephone-exchange circuit-wire, e^4 ; means connected by the action of said buttons, E, for connecting each line-wire with the exchange-wire, e^4 ; additional means controlled by said buttons for forming a connection with said line-wire; the switches controlled by the button, K^2 , one connecting the telephone-circuit with the exchange-tele-

phone, and one controlling a circuit with a source of electrical power utilized by the controlling mechanism controlled by the buttons, E.

89. In a telephone-exchange mechanism, the combination of the outgoing and incoming line-wires; the buttons, E and F, one for each line-wire; the exchange-circuits formed by the wires e^4 and f^4 ; means actuated by the buttons for connecting each line-wire with said exchange-wires, e^4 and f^4 .

90. In a telephone-exchange mechanism, the combination of a series of incoming wires and an outgoing wire; a series of telephones one connected with each incoming wire and all in common connected with the outgoing wire; the buttons, E, one for each incoming wire; the exchange circuit-wires, f^4 and e^4 ; and means for connecting each of the buttons, E with the wire, e^4 , and the outgoing wire with the wire, f^4 .

91. In a telephone-exchange mechanism, the combination of a series of incoming wires and an outgoing wire; a series of telephones one connected with each incoming wire and all in common connected with the outgoing wire; the buttons, E, one for each incoming wire; the exchange circuit-wires, f^4 and e^4 ; means for connecting each of the buttons, E with the wire, e^4 , and the outgoing wire with the wire, f^4 ; and means controlled by the buttons, E, for making a connection with its incoming wire.

92. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire of one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group each series containing a common wire for a group; the buttons, E, one for each incoming wire; the buttons, F, one for each outgoing wire; the exchange circuit-wires, e^4 and f^4 ; means actuated by the buttons, E, for connecting any of the incoming wires with the exchange-wire, e^4 ; and means actuated by the buttons, F, for connecting any of the outgoing wires with the exchange-wire, f^4 .

93. In a telephone-exchange mechanism, the combination of a series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire of one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group each series containing a common wire for a group; the buttons, E, one for each incoming wire; the buttons, F, one for each outgoing wire; the exchange circuit-wires, e^4 and f^4 ; means actuated by the buttons, E, for connecting any of the incoming wires with the exchange-wire, e^4 ; means actuated by the buttons, F, for connecting any of the outgoing wires with the

exchange-wire, f^4 ; and means controlled by said buttons for forming connections with said wires.

94. In a telephone-exchange mechanism, the combination of a mechanism for forming a connection; a controlling mechanism for controlling the connection; an electric circuit for actuating said controlling mechanism; an exchange-telephone; and a button, K^2 , for connecting the exchange-telephone and the controlling-circuit simultaneously.

95. In a telephone-exchange mechanism, the combination of a mechanism for forming a connection; a controlling mechanism for controlling the connection; an electric circuit for actuating said controlling mechanism; an exchange magneto-circuit; and a button, H^2 , for connecting the magneto-circuit and the controlling-circuit simultaneously.

96. In a telephone-exchange mechanism, the combination of a series of brushes arranged to be carried over a series of contact-plates; said contact-plates; a reciprocating means; means carried by said reciprocating means for actuating said brushes; and means for moving said actuating means into the path of the brushes successively.

97. In a telephone-exchange mechanism, the combination of a series of contacts; a brush adapted to pass over said contacts; a constantly-reciprocating means; mechanism carried by said means normally out of the path of said brush; and means for throwing said mechanism into the path of said brush when a connection is desired.

98. In a telephone-exchange mechanism, the combination of a series of contacts; a series of brushes adapted to pass over said contacts; a reciprocating means; mechanism carried by said means normally out of the path of said brushes; and means for throwing said mechanism into the path of said brushes successively.

99. In a telephone-exchange mechanism, the combination of a series of contacts; a series of brushes adapted to pass over said contacts; a constantly-reciprocating means; mechanism carried by said means normally out of the path of said brushes; and means for throwing said mechanism into the path of said brushes successively.

100. In a telephone-exchange mechanism, the combination of a series of contacts; a series of brushes adapted to pass over said contacts; a reciprocating means; mechanism carried by said means normally out of the path of said brushes; means for throwing said mechanism into the path of said brushes successively; and means for returning said mechanism to the path of the initial brush after the completion of the series.

101. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms; a reciprocating mechanism; and mechanism actuated by said reciprocating mechanisms for bringing said connecting

mechanisms successively back to normal after connections.

102. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms; a reciprocating mechanism; means actuated by said reciprocating mechanism to act upon said connecting mechanisms successively; and mechanism actuated by said reciprocating mechanisms for bringing said connecting mechanisms successively back to normal after connections.

103. In a telephone-exchange mechanism, the combination of a series of brushes to be carried successively over a series of contact-plates; said contact-plates; a reciprocating means; and means carried by said reciprocating means for returning said brushes successively to normal after connections.

104. In a telephone-exchange mechanism, the combination of the brush-rods, $C C'$; reciprocating means carrying the rods, $R R'$, having a series of notches, $r r'$, thereon; a block, S , carried by said rods; spring-catches carried by said block, and adapted to engage the said notches; means for moving one of said rods, $R R'$, axially, relatively to the other rod; and means carried by the block for actuating the brush-rods.

105. In a telephone-exchange mechanism, the combination of the brush-rods, $C C'$; reciprocating means carrying the rods, $R R'$, having a series of notches, $r r'$, thereon; a block, S , carried by said rods; spring-catches carried by said block, and adapted to engage the said notches; means for moving one of said rods, $R R'$, axially, relatively to the other rod; means carried by the block for actuating the brush-rod; and means for returning the block after the completion of its movement across the rods.

106. In a telephone-exchange mechanism, the combination of the brush-rods, $C C'$; reciprocating means carrying the rods, $R R'$, having a series of notches, $r r'$, thereon; a block, S , carried by said rods; spring-catches carried by said block, and adapted to engage the said notches; means for moving one of said rods, $R R'$, axially, relatively to the other rod; means carried by the block for actuating the brush-rods; a spring-drum; a cord carried by said drum and secured to said block; and means for throwing said catches out of action at the completion of the movement across said rods, $R R'$.

107. In a telephone-exchange mechanism, the combination of the brush-rods, $C C'$; reciprocating means carrying the rods, $R R'$, having a series of notches, $r r'$, thereon; a block, S , carried by said rods; spring-catches carried by said block, and adapted to engage the said notches; means for moving one of said rods, $R R'$, axially relatively to the other rod; means carried by the block for actuating the brush-rods; means for returning the block after the completion of its movement across the rods; and means for throwing said

catches into action again at the completion of their return movement.

108. In a telephone-exchange mechanism, the combination of the brush-rods, C; the shaft, R; the collar, s' , carried by said shaft, and locked against rotation thereon, but free to move axially thereon; a lug carried by said collar; means for rocking said collar to bring said lug into and out of the path of the rods, C; and means for reciprocating the rod, R, to carry the lug carried by the collar, s' , into the path of the rod, C.

109. In a telephone-exchange mechanism, the combination of the brush-rods, C; the shaft, R; the collar, s' , carried by said shaft, and locked against rotation thereon; but free to move axially thereon; a lug carried by said collar; electrically-controlled means for rocking said collar to bring said lug into and out of the path of the rods, C; and means for reciprocating the rod, R, to carry the lug into the path of the rod, C.

110. In a telephone-exchange mechanism, the combination of the brush-rods, C; the shaft, R; the collar, s' , carried by said shaft, and locked against rotation thereon, but free to move axially thereon; a lug carried by said collar; means for rocking said collar to bring said lug into and out of the path of the rods C; the coil, N; brush, L^2 ; contact-plates in the path of the brush, L^2 ; means for carrying the brush, L^2 , and the rod, R, together; the arm, n^4 , arranged as an armature for the coil, N; mechanism for throwing the arm, n^4 , into position and to be influenced by the coil, N, at the beginning of a stroke; means for exerting rocking pressure on the rod, R, in opposition to the action of the coil, N, on the arm, n^4 ; a connection between the contact, L^2 , and the coil, N; and means for breaking the circuit through said brush as described.

111. In a telephone-exchange mechanism, the combination of the brush-rods, C; the bars, a , arranged to be actuated by the brushes on the rods, C; a series of plates, l , corresponding to the bars, a ; a reciprocating rod, R; a collar, s' , thereon having a lug arranged to be rocked into and out of the path of the rods, C; a brush arranged to move over the contact-plates, l ; a coil connected with said brush; an arm, n^4 , arranged on the shaft, R, and to act as an armature for the brush, N; means for exerting rotative pressure on the rod, R, in opposition to the effect on the arm, n^4 ; and means for breaking the circuit through the plate, l , corresponding to the bars, a , with which a connection is desired.

112. In a telephone-exchange mechanism, the combination of the coil, O; the rod, O'; a connecting mechanism; a reciprocating mechanism arranged to act upon said connecting mechanism and upon said rod, O', to reciprocate the same; a catch controlled by the coil, O, for locking the rod, O', in position to act upon the reciprocating mechanism to form a connection.

113. In a telephone-exchange mechanism,

the combination of the connecting mechanism; the rods, R R', carrying a setting mechanism acting upon said connecting mechanism having a step-by-step mechanism on said rods, R, for carrying said setting mechanism along said rods, R R'; the rod, O'; means carried by said rod for actuating said step-by-step mechanism; and the coil, O, for setting said rod, O', in actuating position; and means for controlling the circuit through the coil, O.

114. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms arranged to be actuated successively; the rods, R R', having the notches, r r' , thereon; the block, S, arranged to slide thereon; spring-catches, s^{11} , s^{12} , arranged to operate in said catches; cams on said catches; means acting upon said cams for locking said catches out of position at the completion of their movement; and means for throwing said cam-actuating mechanism out of operative position at the completion of a return movement.

115. In a telephone-exchange mechanism, the combination of a series of connecting mechanisms adapted to be acted upon successively; the rods, R R', having the notches, r r' , thereon, respectively; the block, S, arranged on said rod; spring-catches s^{11} s^{12} , arranged to act in said notches; cam-heads, s^{17} , s^{18} , on said catches; cam-levers, s^{14} , arranged to act upon said cam-heads; a contact-arm on said cam-lever; and contact-posts at each end of the rods, R R', for throwing said cam-lever into and out of operative position.

116. In a telephone-exchange mechanism, the combination of the brush-rods, C; a block-carrying mechanism adapted to press said rods in successively; spring-catches, s^6 , carried by said mechanism and adapted to engage said rods on the outward movement of said actuating mechanism.

117. In a telephone-exchange mechanism, the combination of the line-wires, A and B; bars, a and b , connected therewith; brush-rods, C, arranged to be moved across the bars, a ; brush-rods, C', arranged to be moved across the bars, b ; a reciprocating mechanism; a setting mechanism comprising the block, S; collars, s' and s^2 , having the projecting lugs thereon; a step-by-step mechanism for moving said block across said reciprocating mechanism along the path of the rods, C and C'; the arms, n^4 and n^5 , on said rods, R R', respectively; the arm, n^8 , on the rod, R'; the coils, N and N', arranged to act upon the arms, n^4 and n^5 ; the series of plates, l and m , occupying the same space as the bars, a and b ; the brushes, L^2 and M^2 , arranged to move over said plates; a connection between said brushes and said coils, N and N', with a source of electrical supply; means for breaking the circuit on the plates, l and m , corresponding to the bars, a and b , utilized in making the connection; mechanism arranged normally out of the path of the arms, n^4 and

n^8 ; and means for locking said mechanism in the path of said arms when a connection is desired.

118. In a telephone-exchange mechanism, 5 the combination of a constantly-reciprocating means; a connecting mechanism actuated by said means for forming a connection, said connecting mechanism being normally out of engagement with said means, and means 10 for disengaging the setting mechanism from the reciprocating means after forming said connection without breakingsaid connection.

119. In a telephone-exchange mechanism, 15 the combination of a constantly-reciprocating means; a connecting mechanism actuated by said means for forming a connection, said connecting means being normally out of engagement with said means; means for disengaging the setting mechanism from the re- 20 ciprocating means after forming a connection

without breaking said connection; and means for breaking said connection.

120. In a telephone-exchange mechanism, the combination of a constantly-reciprocating means; a connecting mechanism actuated by 25 said means for forming a connection, said connecting means being normally out of engagement with said means; means for disengaging the setting mechanism from the re- 30 ciprocating means after forming a connection without breaking said connection; and means for breaking said connection and bringing the parts to normal.

In testimony whereof I affix my signature in presence of two witnesses.

HARLEN P. SNOW.

Witnesses:

H. C. LORD,
MARTHA BERRY.