(No Model.)

4 Sheets—Sheet 1.

J. V. M. BARTELOUS.

SWITCHING APPARATUS FOR TELEPHONE LINES.

No. 290,730. Patented Dec. 25, 1883.

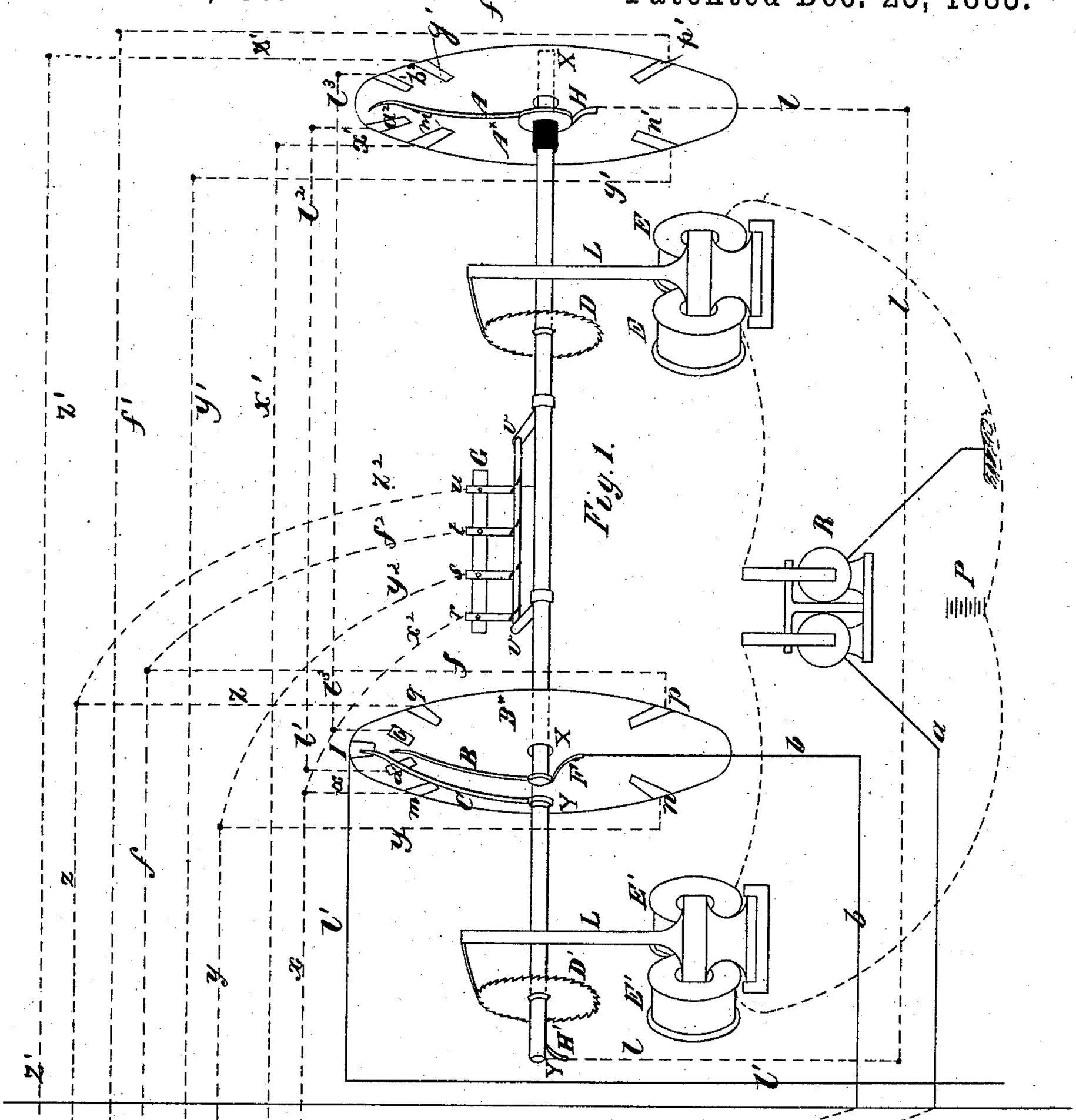

Fig. 1.

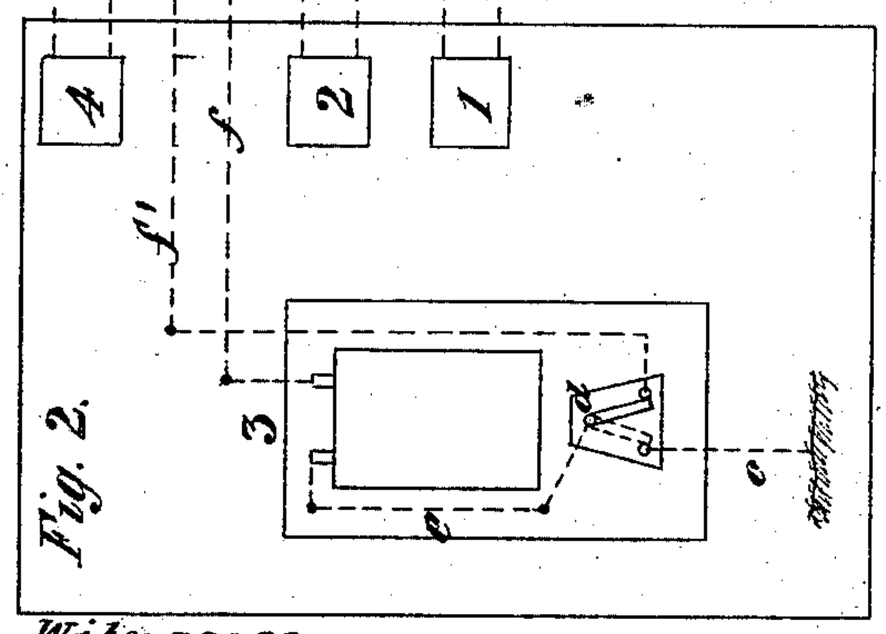

Fig. 2.

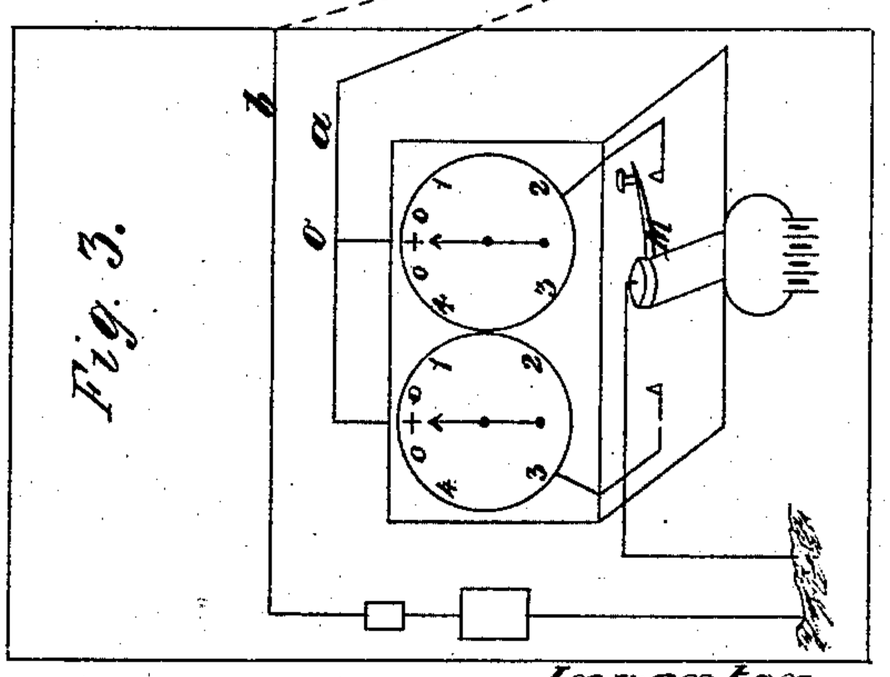

Fig. 3.

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(No Model.) 4 Sheets—Sheet 2.

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Fig. 5.

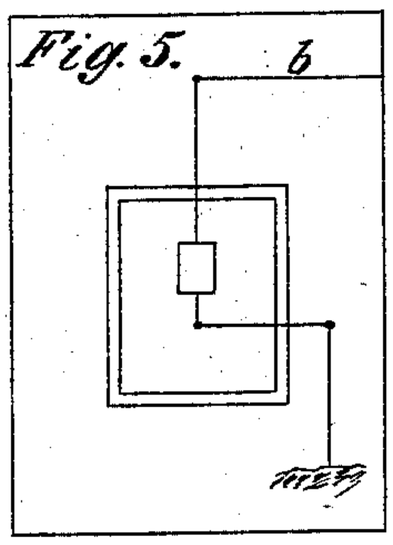


Fig. 4.

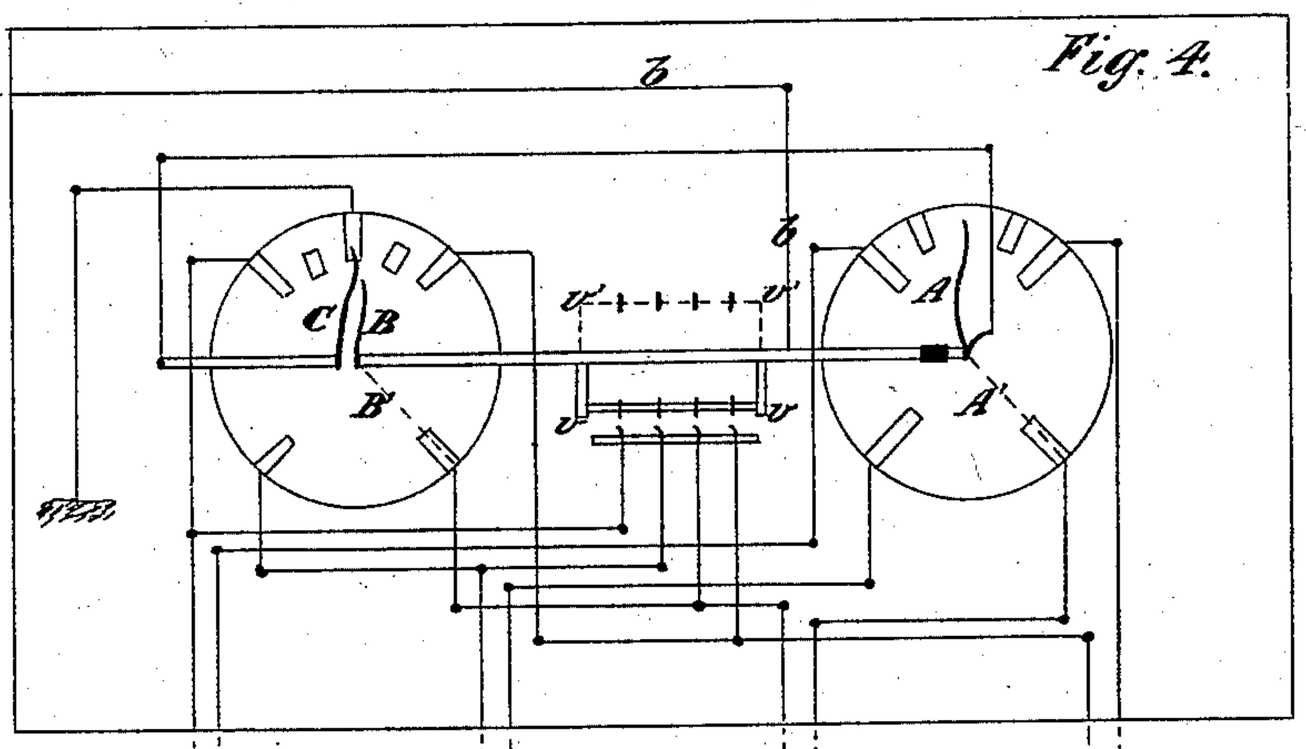


Fig. 5*.

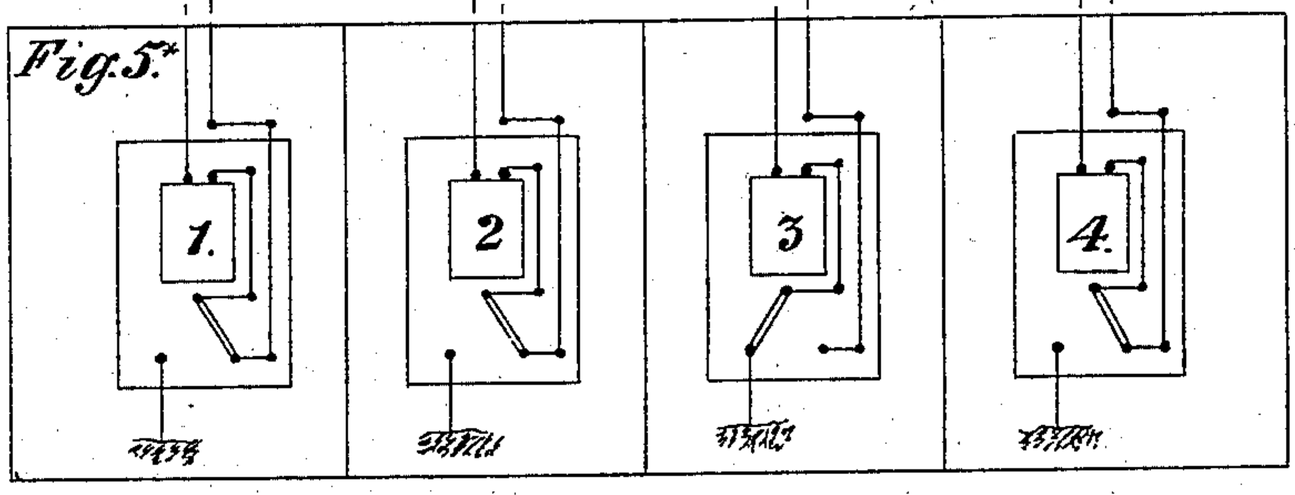


Fig. 7.

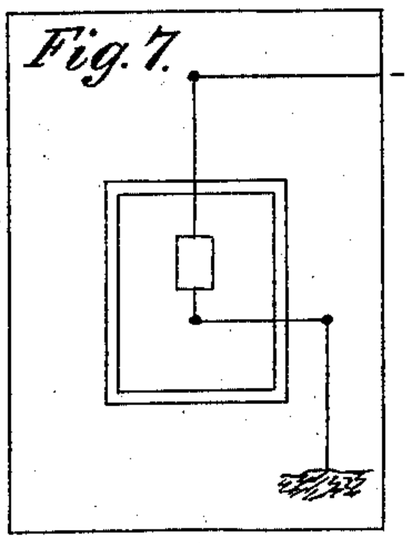


Fig. 6.

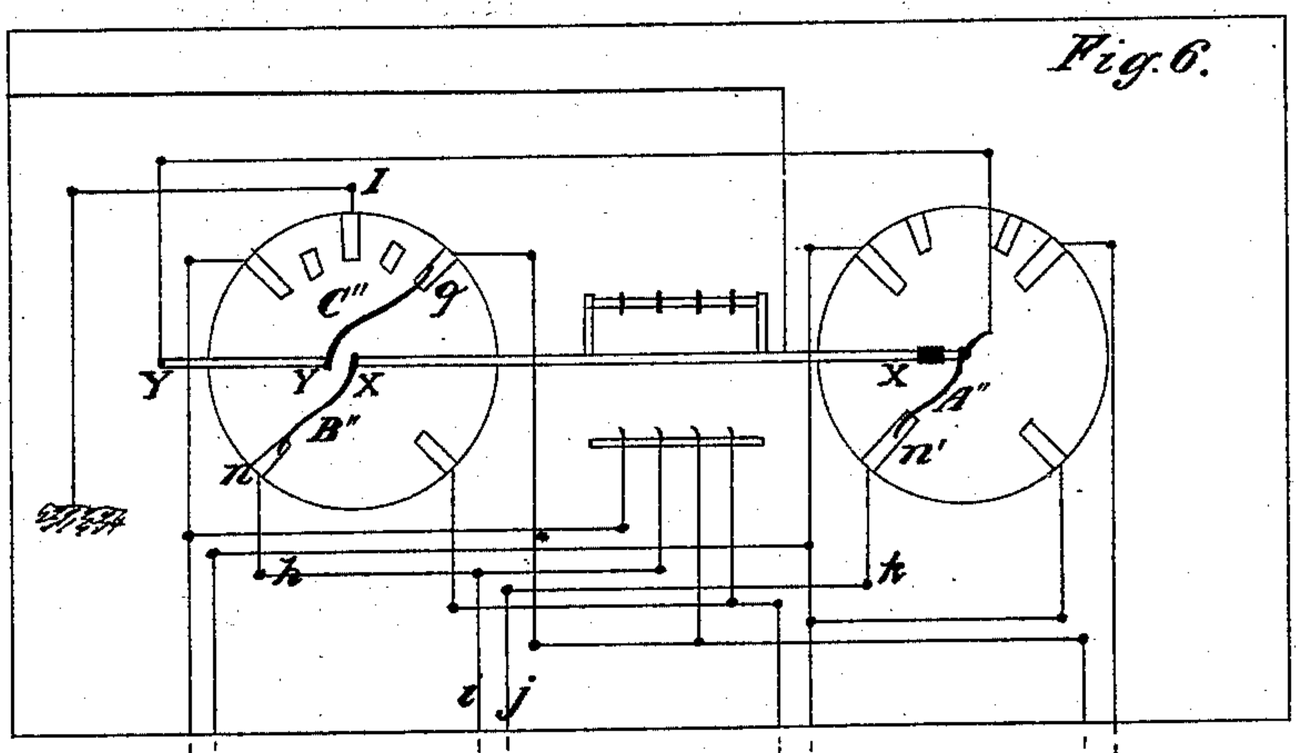
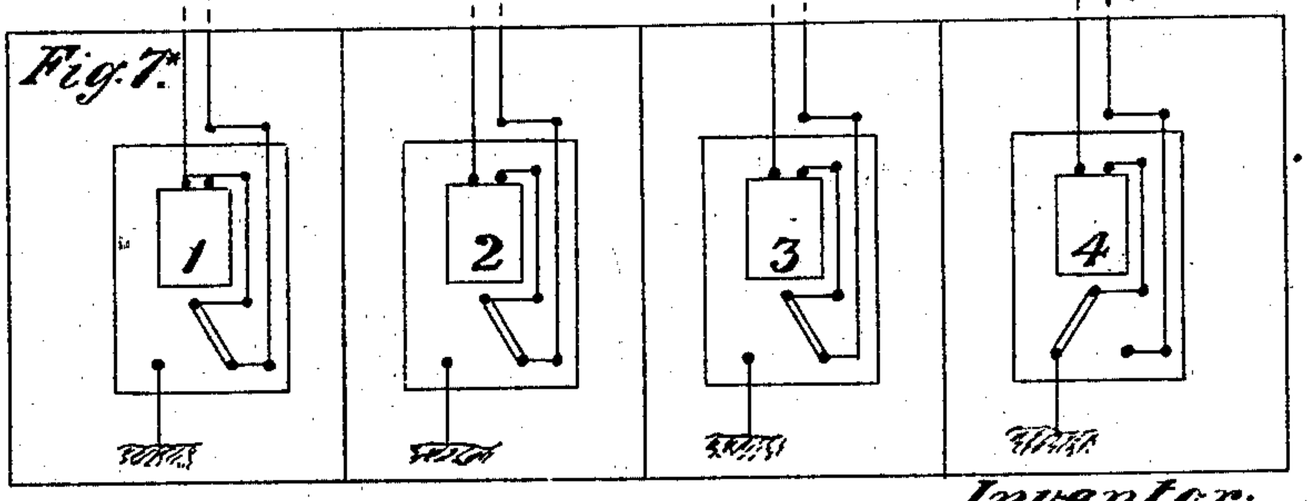


Fig. 7*.



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(No Model.) 4 Sheets—Sheet 3.

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SWITCHING APPARATUS FOR TELEPHONE LINES.

No. 290,730. Patented Dec. 25, 1883.

Fig. 9.

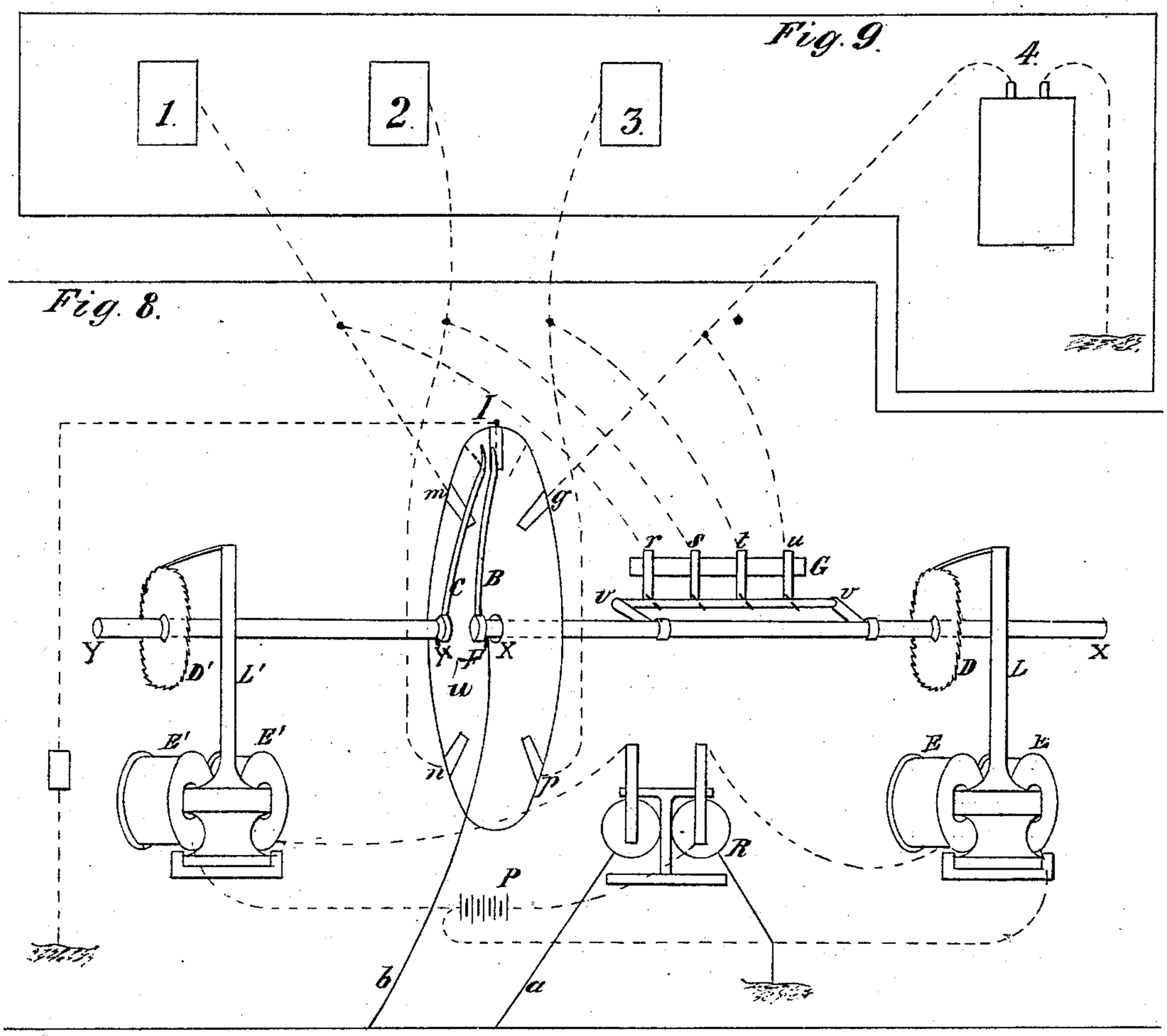
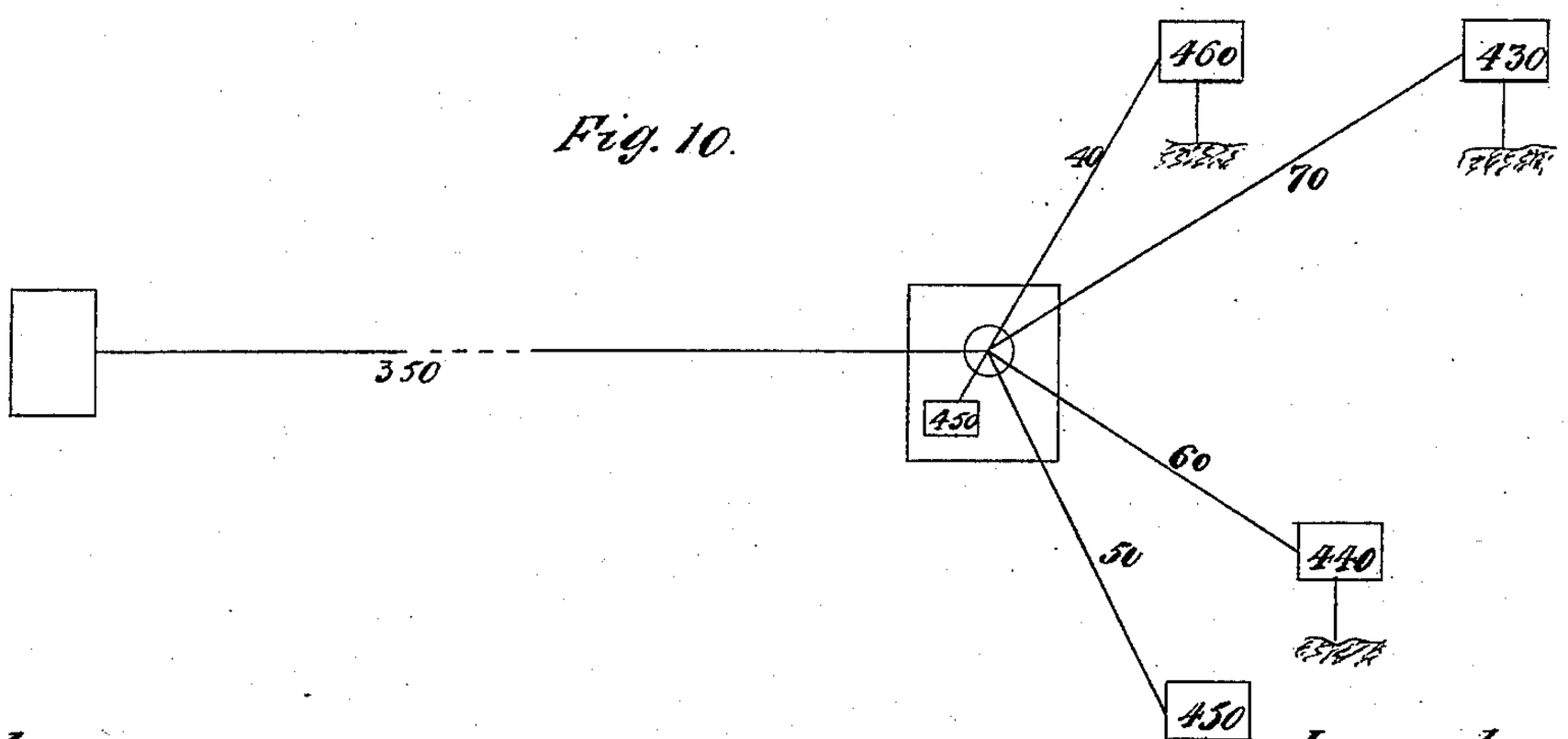


Fig. 8.

Fig. 10.



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(No Model.) 4 Sheets—Sheet 4.

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SWITCHING APPARATUS FOR TELEPHONE LINES.

No. 290,730. Patented Dec. 25, 1883.

Fig 11.

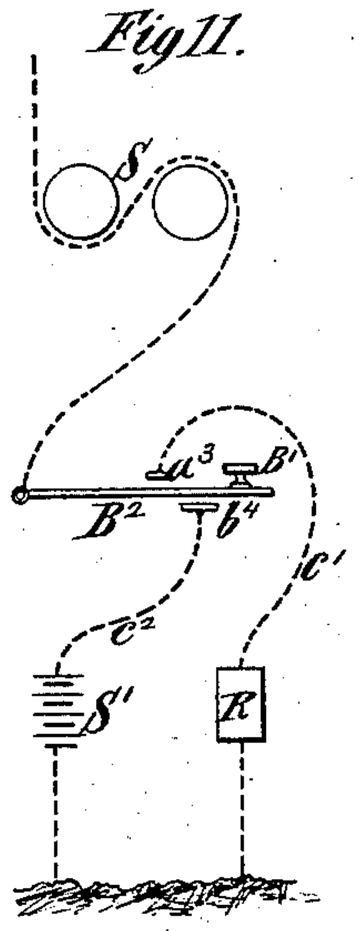
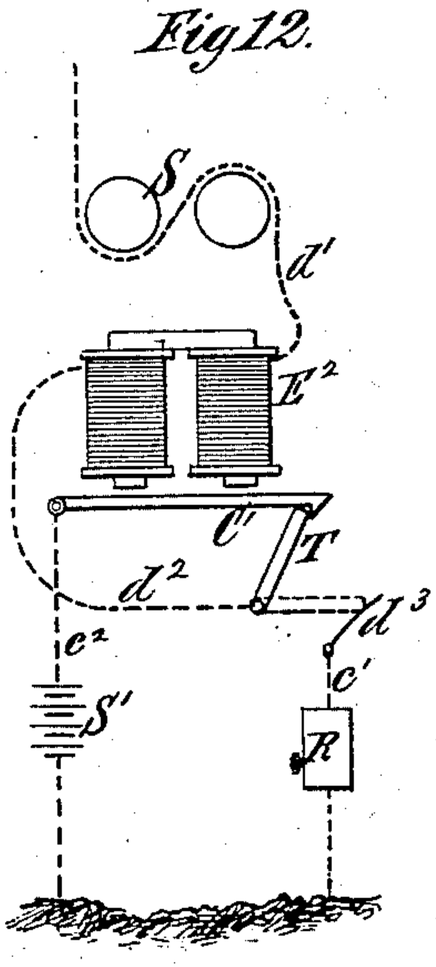


Fig 12.



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UNITED STATES PATENT OFFICE.

JACQUES VICTOR MICHEL BARTELOUS, OF BRUSSELS, BELGIUM.

SWITCHING APPARATUS FOR TELEPHONE-LINES.

SPECIFICATION forming part of Letters Patent No. 290,730, dated December 25, 1883.

Application filed June 15, 1882. (No model.) Patented in Belgium July 22, 1880, No. 52,081; in France August 4, 1880, No. 138,097; in Germany August 17, 1880, No. 15,561, and in England February 11, 1881, No. 607.

To all whom it may concern:

Be it known that I, JACQUES VICTOR MICHEL BARTELOUS, of Brussels, in the Kingdom of Belgium, have invented certain new and useful Improvements in Apparatus Employed for and in Telegraphic and Telephonic Communications, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to means which permit the sending of an electric current on a single principal wire to any determined point, and afterward making the current pass, as may be desired, on one or more secondary wires radiating from that point. The invention is applicable for all electric currents used for telegraphic or telephonic purposes; but, for the purpose of illustration, I will explain its employment in the case of a central telephonic office intended to serve a certain number of subscribers, all dependent upon an auxiliary office operating automatically—that is to say, without any employé. To avoid complexity in the drawings, I will suppose the number of subscribers to be only four, though the number may be as much greater as the service requires. A single principal wire leaves the central office and comes into an auxiliary automatic office, whence radiate four secondary wires, which go to the houses or places of the four subscribers. It is necessary to put these subscribers in communication for conversation with each other and also with the central office, and to enable them to receive from the latter all communications without the intermediation of any employé at the auxiliary office, and for that purpose I employ in the auxiliary office an apparatus, which I term the "automatic communicator."

Sheet I of the drawings exhibits a diagram of a central office and its apparatus, a perspective view of the automatic communicator at an auxiliary office, and a diagram of the apparatus to be employed by a subscriber. In this sheet, Figure 1 represents the auxiliary office; Fig. 2, the subscribers' offices, and Fig. 3, the central office. Sheet II: Fig. 4 represents the auxiliary office; Fig. 5, the central office, and Fig. 5*, four subscribers' offices, illustrating the apparatus at one stage of operation. Fig. 6 represents the auxiliary office; Fig. 7, the central office, and Fig. 7*, four subscribers' offices, illustrating the apparatus at another stage of the operation. In Sheet III, which illustrates a modification of my invention, Fig. 8 represents the auxiliary office; Fig. 9, four subscribers' offices; and Fig. 10, a diagram of a whole system, including central office, auxiliary office, and subscribers' offices and their connections; and Figs. 11 and 12 illustrate details hereinafter described.

The automatic communicator is composed, as shown in Figure 1, of two metallic shafts, X X and Y Y, susceptible of deriving each an independent rotary motion from the action of the electro-magnets E E′, of which the armatures furnished with levers L L′, and pawls act upon ratchet-toothed wheels D D′ or in any other suitable manner. The power necessary for these magnets is furnished by a local battery, P, of which the current is sent into one or the other electro-magnet, according as the current from the central office, Fig. 3, is positive or negative. To realize this effect, it suffices that the wire *a* connects with a current-reversing relay, R, which closes in one direction or the other the circuit of the local battery. The shaft X X carries two metallic needles, A B, which are moved each upon a stationary disk, A* or B*, made of non-conducting material, but upon the surface of which are furnished four metallic contacts corresponding with the number of subscribers to be served, as shown at *m n p q* on the disk B*, and *m′ n′ p′ q′* on the disk A*. These contacts constitute the points of departure of the branch lines or wires *x y f z x′ y′ f′ z′* to the houses or places of the four subscribers connected with the automatic auxiliary office. During the rotation of the shaft X the subscribers are put successively into communication with the central office by means of the needle B, shaft X, the friction-piece F, attached to the disk B* and bearing against the shaft, and the wire *b b*. Before arriving at the points *m n p q*, the secondary-wires *x y f z* are divided, and one of the bifurcations or branches of each connects with one of four flexible

teeth, *r s t u*, of a comb of which the head or back G is of insulatory material. From the points of division four wires, x^2 y^2 f^2 z^2, lead to these teeth. When the apparatus is at rest these teeth press against as many points carried by a bar, *v*, which is attached to and parallel with the shaft X. Thus the communication exists between the central office and all of its subscribers in such manner that if the wire of each subscriber, after having traversed its receiver, goes directly to earth, as is the ordinary practice, the call of a subscriber is heard not at the central office, which is in general far off, but at the place of the nearest subscriber, because of the lesser resistance. I obviate the inconvenience above mentioned in either of two ways—viz., by the employment of second or return wires x' y' f' z', leading from the places of the subscribers to the second disk A*, similar to B*, and having corresponding metallic contacts, m' n' p' q'; or else by the introduction of resistances suitably graduated in the circuit of the calls. The last-mentioned means will be hereinafter described. As to the first, it suffices to connect the two wires at the place of each subscriber with the switch *d* of the commutator shown in Fig. 2. If, then, a subscriber wishes to call the central office, he shifts this switch and puts it in communication with the ground-wire. Then his call-current can only pass to the central office. Through Fig. 1 the circuit may be traced from one subscriber, No. 3, located in Fig. 2 to the central office, Fig. 3, by *c d e f* f^2 *t v* X F *b*.

In Fig. 4, Sheet II, is indicated in dotted outline at A′ B′ the position of the needles A B when the central office, Fig. 5, to respond to the call of the subscriber No. 3, Fig. 5*, has put itself alone in communication with the line-wire *b*, terminating in the auxiliary office. It is apparent that since the first movement transmitted to the shaft X the bar *v* has quitted contact with the comb to take, after several interruptions of currents, the position v' v', and consequently cuts off the communication of all the other subscribers.

The operation which I have proposed for the subscriber to call the central office, and which consists in the displacement of the switch of his commutator, presents, besides the advantage already indicated, the following: In the state of rest of the automatic auxiliary-station apparatus and of the subscribers' instruments it is easy to see that a current sent from the central office finds no issue. That being the case, if, during an exchange of conversation between the central office and a subscriber, another subscriber seeks to call the central office by putting his commutator on the ground-wire, his call cannot be produced; but if he leaves his commutator in this situation, the operator at the central office, by replacing, at the end of the conversation with the first subscriber, the organs of the commutator at the point of rest, shall ascertain that the current passes somewhere; and by passing a call-current over the line will actuate the call of the subscriber who has been waiting the communication, who will thus be informed that the line is at his disposal.

I will now describe how a subscriber is called from the central office. Suppose, for example, that it is desired to call the subscriber No. 3, represented in Fig. 2. The current is sent from the central office through the wire *a* to act upon the polarized relay R, and through it to cause the current from the local battery P to act upon the magnet E, and by operating its armature to turn the shaft X sufficiently to bring the needles B A upon the contact-pieces *p p′* on the disks B* A*. Then a call-current, produced by a battery or a magneto-electric generator at the central office, having one of its electrodes at the earth and the other at the line *b*, Figs. 3 and 1, will arrive at the clamp or rubber F and pass by the needle B, contact *p*, and wire F, through the apparatus of the subscriber No. 3, Fig. 2, and, by ringing the bell, will call the subscriber. On leaving the apparatus the current will pass by the wire *e*, switch *d*, and thence by the wire *f′* to the contact-piece *p′* of the disk A*. The finger A, which is at this time on the contact-piece *p′*, is insulated from the shaft X; but it has connected with it a clamp or rubber, H, from which leads a wire, *l*, to the shaft Y. The current passes from the contact *p′* through the finger A, the clamp or rubber H, and wire *l* to the clamp or rubber H′, and thence by the needle C, which is now at rest or on the contact-piece I, connected by the wire *l′* with the earth; and thus the current sent from the central office, after having traveled over the circuit above described and acted on the bell of subscriber No. 3, passes to the earth.

Figs. 6, 7, and 7* show how a subscriber, No. 4, of the secondary group may obtain communication with another subscriber, No. 2, connected with the same automatic or auxiliary office. The central office, Fig. 7, called by the subscriber No. 4, operates the shaft X X at the auxiliary office in such manner as to carry the two needles A and B to the positions indicated by A″ and B″ upon the contacts *n* and *n′*. The current passes thus by the wire *h i* to the subscriber No. 2, traverses his instrument and acts upon his call, returns by the wire *j k* to the contact *n′*, upon which is found the needle A″. This needle is not in electric communication with the shaft X X, but, as may be seen in Fig. 1, with a friction device, H, a conducting-wire, *l*, a second friction device, H′, and a shaft, Y. This latter carries a needle, C, which, at rest, presses on a contact, I, on the stationary disk, B*, which communicates with the ground. By reversing the current, which has acted on the electro-magnet E, and passed along the shaft X, the electro-magnet E′ and the shaft Y are acted upon. By that means the needle C may be brought, as shown in Fig. 6, to the position

C″ on the contact *q*, corresponding with the subscriber No. 4; and the current, instead of taking earth at automatic or auxiliary stations, will take it at the place of the subscriber who had placed his commutator to receive the call of the central office. It suffices, then, to put this automatic apparatus in operation to send from the central office on the working-wire the number of positive or negative emissions necessary to bring the needles upon the contacts of the subscribers. For that purpose it is necessary to have at the central office an apparatus which indicates to the operator and enables him to control the position of the needles of the automatic commutator of the auxiliary office. This indication and control may be made by different means. One of these consists in a current-changer, Fig. 3, causing, according as its key M may be turned to the right or left, positive or negative currents, on the conducting-wire *a*. This wire is for this purpose bifurcated at O to connect with the contacts of the key, and upon each of these bifurcations or branches is a small electro-magnet, of which the armature produces the movement of a needle upon a dial having as many divisions, as there are successive contacts encountered by the needles of the commutator of the auxiliary office on its disks.

Instead of employing a key, M, there may be employed at the central office an automatic apparatus to operate the current-changer, for producing the necessary number of emissions of the circuit.

I will describe, also, another arrangement permitting the central office to inform itself of the position of the needles of the commutator of the auxiliary office in case of derangement of the latter without requiring to call any subscriber. It has been seen that when the apparatus at the auxiliary office and at the subscribers' places are at rest a current should not find a passage along the line-wire. This condition is maintained when the needles B A are in vertical positions, and off the contacts *m m′*, &c. On each side of the needle B, when in a vertical position, are contacts *a′ b′*, and the needle B meets these contacts on its first movement of departure from a vertical position and immediately before its return thereto. On the disk A*, in similar positions, are contacts a^2 b^2, connected with the contacts *a′ b′* by wires l^2 l^3, so as to establish in the apparatus a local circuit giving passage to the current. When the needle B is on the contact *b′*, the needle A will be on the contact b^2, and the current can then pass from the wire *b* through the clamp or rubber F, finger B, contact *b′*, wire l^3, contact b^2, needle A, clamp or rubber H, wire *l*, shaft Y, needle C, contact I, and wire *l′* to the earth. The needle C in this movement does not touch these points, as the latter are not long enough to be touched by it. The known succession of these points renders it easy to recognize at the central office the position of these needles of the communicator, and to place the indicators on the dials of the manipulator in agreement with the actual position of the organs of the commutator, if one or the other should have been deranged.

The preceding description supposes two wires between the communicator and each subscriber. It now remains to explain by what means I dispense with the return-wire. Suppose that the line connecting the central office with the automatic auxiliary station, as shown in Fig. 10, to present a resistance of three hundred and fifty units, and that the lines which connect the latter with different subscribers have, respectively, resistances of forty, fifty, sixty, and seventy units. If, the apparatus being in repose, a subscriber calls, the calling-current passes by the line offering least resistance—that is to say, always to another subscriber. If, on the contrary, I introduce in the circuits of the different subscribers resistances such that all of the lines may be brought to a fixed degree of resistance greater than that of the line of the central office—for example, to five hundred units—a sufficient current for the call will be conducted to this last point, while the part of the current which is divided between the wires of the subscribers is insufficient in each of those to move the call-bells. The automatic apparatus combined with this introduction of complimentary resistances may be reduced to the organs represented in Fig. 8, to wit: first, a disk, *m n p q*, with the two needles B C, whose two shafts are in electric communication, as indicated by the dotted line *u* in Fig. 8, while the independence of their movements is preserved which permits one to be turned by positive currents and the other by negative currents; second, a bar, *v v*—such as is shown in Fig. 1 and hereinbefore described—connecting with one of the shafts and communicating, when at rest, by the flexible teeth of a comb with the wires of all the subscribers.

If it is necessary to give communication to one of the subscribers—No. 3, for example—there are sent from the central office the number of positive or negative currents necessary, in order that the needle B, carried by the shaft X, may come to a stop on the contact *p* while leaving the needle C at rest. If it is desired to give a double communication—as, for example, if No. 1 desires to speak with No. 4, this demand having been received while the apparatus was left at rest—I begin by bringing the needle B upon the contact *q*, which permits the calling of the subscriber No. 4, then reversing the current in the operating-line to act in a reverse direction on the relay R, the local battery P is caused to act on the magnet E′ to produce the movement of the shaft Y and advance the needle C, which will be arrested on the contact *m″*. Now, as is above stated, the two shafts X and Y are in electrical communication with each other, and also with the line *b*, coming from the central office. It thus

results that the subscribers may be informed of the establishment of communication between them, and they are able to inform the central office when their conversation is terminated. After that information the central office will put the apparatus in the position of rest, and it will then be ready for a new communication. The resistances will be placed in the circuit of the bells, and will be thus suppressed while the telephone is unhooked or taken down. I can, for example, arrange them as shown in Figs. 11 and 12.

In Fig. 11, B′ is a button mounted upon a metallic plate, B^2, which, when at rest, bears against a contact, a^3. The call-current coming from the central office acts upon the bell-magnet S, and the wire c' conducts the current from the plate B^2 across the resistance R to the earth. When the subscriber wishes to call, he presses the button B′, and thereby the plate B^2 is pressed down upon the contact b^4, which puts it by a wire, c^2, into communication with a battery or magneto-electric generator, S′, the action of which serves to inform the central office. This arrangement does not permit the subscriber to take what I shall term the "waiting position" when the line of the central office is occupied by another subscriber, and oblige him to call again if the first trial has not succeeded. The second arrangement, that illustrated in Fig. 12, enables the subscriber to inform the central office of this delay, and enables him to be informed by the central office when the line is free. In Fig. 12 the current, on leaving the bell-magnet S, is conducted by a wire, d', to an electro-magnet, E^2, and thence by the wire d^2 to the point of attachment of a signal or drop, T. When the signal or drop T falls, it makes contact with a piece, d^3, and the current thence passes by a wire, c', through a resistance device, R, to the earth. To call up the central office, the subscriber raises the signal T and maintains it pressed against the armature C′ of the magnet E^2. In this position the current of a battery or generator, S′, passes by a wire, c^2, ending at the armature C′, and crosses the said armature, the signal T, the wire d^2, and bell S, and thence to the central office. If, in consequence of the main line being at this time in use, the subscriber's line will be severed at the auxiliary station and the current sent will not produce any effect, the subscriber will be informed by the failure of the bell to work that the line is in use. The signal T is then hooked up to the armature C′ in the position shown in full lines in Fig. 12, where it will be retained. When the central office, having replaced the automatic communicator at a state of rest, sends a current into the line, such current will pass into the wire of the subscriber which is in a state of waiting, for the reason that the latter will have suppressed its complemental resistance. By the action of the magnet E^2, the armature C′ will be drawn up, releasing the signal T and allowing it to fall, thereby notifying the subscriber that the line is free. In Fig. 10 the ciphers of the complemental resistance indicated should be obliged to form, with the resistances of the lines, the cipher 500 units.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The automatic communicator herein described, consisting of the combination of two shafts capable of turning independently of each other, a disk provided with contacts connected with the places of the several subscribers, and with a contact connected with the earth, a needle on the one shaft adapted to bear upon the contacts connected with the subscribers when its shaft is rotated, and a needle on the other shaft adapted to bear upon the earth-contact when the shafts are at rest, substantially as described.

2. The combination, with the shafts X Y, carrying the needles B C, the insulating-disk B*, provided with contacts connected with the several subscribers, and a contact connected with the earth, electro-magnets and devices operated thereby to rotate said shafts independently of each other, a local battery and circuit for the electro-magnets, and a polarized relay, all arranged at the auxiliary office, of means at the central office for sending currents of opposite polarity to said relay and causing the relay to close the circuit through one or other of the said electro-magnets, substantially as described.

3. The combination of the shaft X and its needle B, the insulating-disk B*, provided with contacts connected with the several subscribers' branch wires leading from the subscribers' wires to a comb, a bar carried by said shaft and carrying-points adapted to make contact with the teeth of the comb, all arranged at the auxiliary office, and means at the central office for transmitting currents for rotating said shaft, substantially as described.

4. The combination of the two shafts X Y and their needles B A C, the insulating-disks B* A*, provided with contacts connected with the several subscribers by direct and return wires, electro-magnets and devices for rotating said shafts independently of each other, and means at the central office for transmitting currents of opposite polarity to said magnets, all substantially as described.

5. The combination of the two shafts X Y and their needles B A C, the insulating-disks B* A*, provided with contacts connected with the several subscribers by direct and return wires, and with other contacts connected with each other to form a local circuit, electro-magnets and devices for rotating said shafts independently of each other, and means at the central office for transmitting currents of opposite polarity to said magnets, substantially as described.

6. The combination of the shafts X Y and their needles B A C, the disk B*, provided with contacts connected by direct wires with the several subscribers, the disk A*, provided

with corresponding contacts connected by return wires with the several subscribers' branch wires leading from the direct wires of the several subscribers, a comb, a bar connected with the shaft X, and carrying contact-points corresponding to the teeth of said comb, electromagnets and devices for rotating said shafts, and means for transmitting currents from the central office to said magnets, substantially as described.

7. The combination, with the auxiliary communicator constructed substantially as herein described, of means at the central office for transmitting currents to operate said communicator, direct and return wires connecting the several subscribers with the communicator, a wire connecting the subscribers with the central office, and a switch at the place of each subscriber for grounding the direct wire to call the central office, substantially as described.

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