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M. FREUDENBERG.

AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

No. 556,007. Patented Mar. 10, 1896.

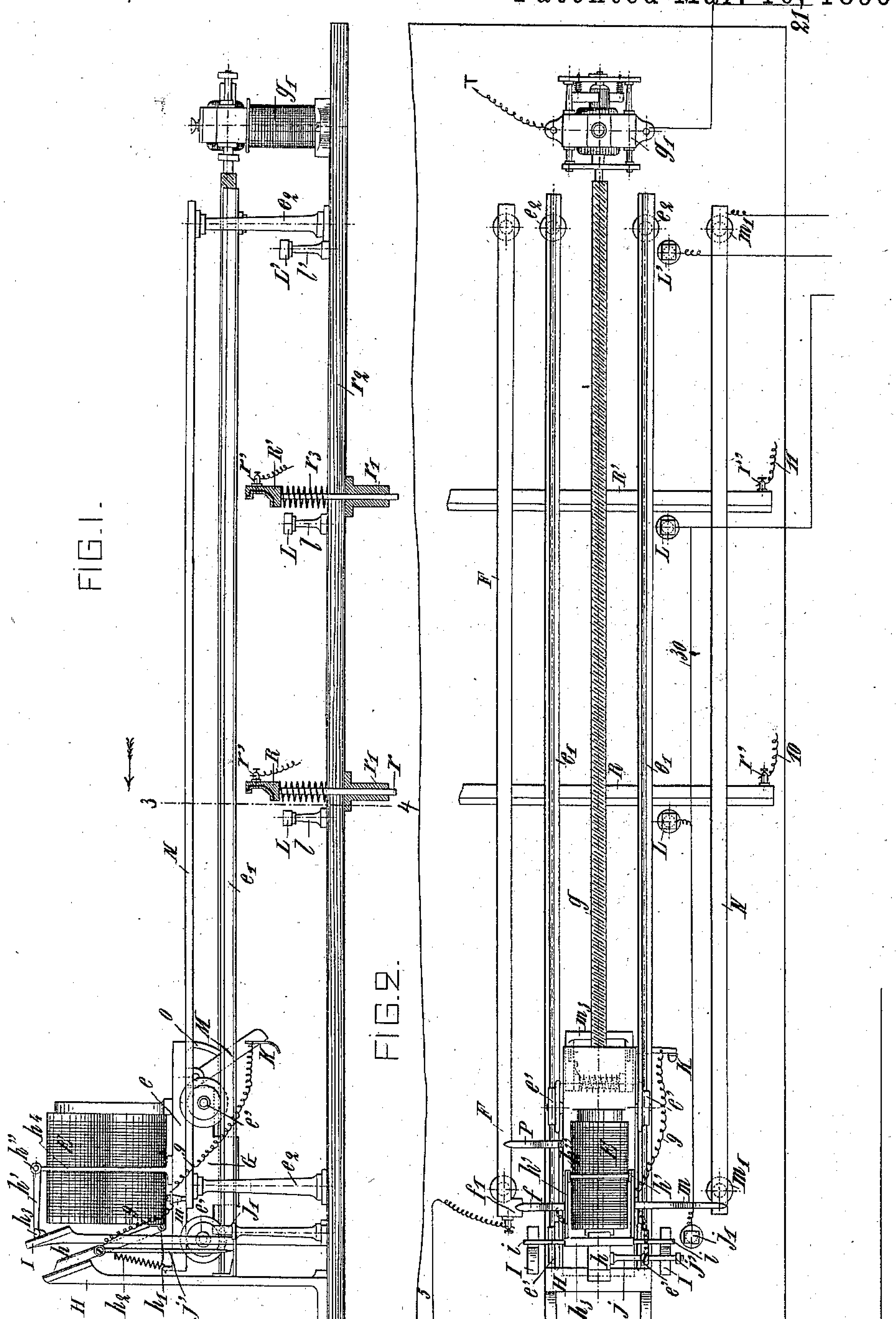

FIG. 1.

FIG. 2.

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(No Model.)

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

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FIG 6.

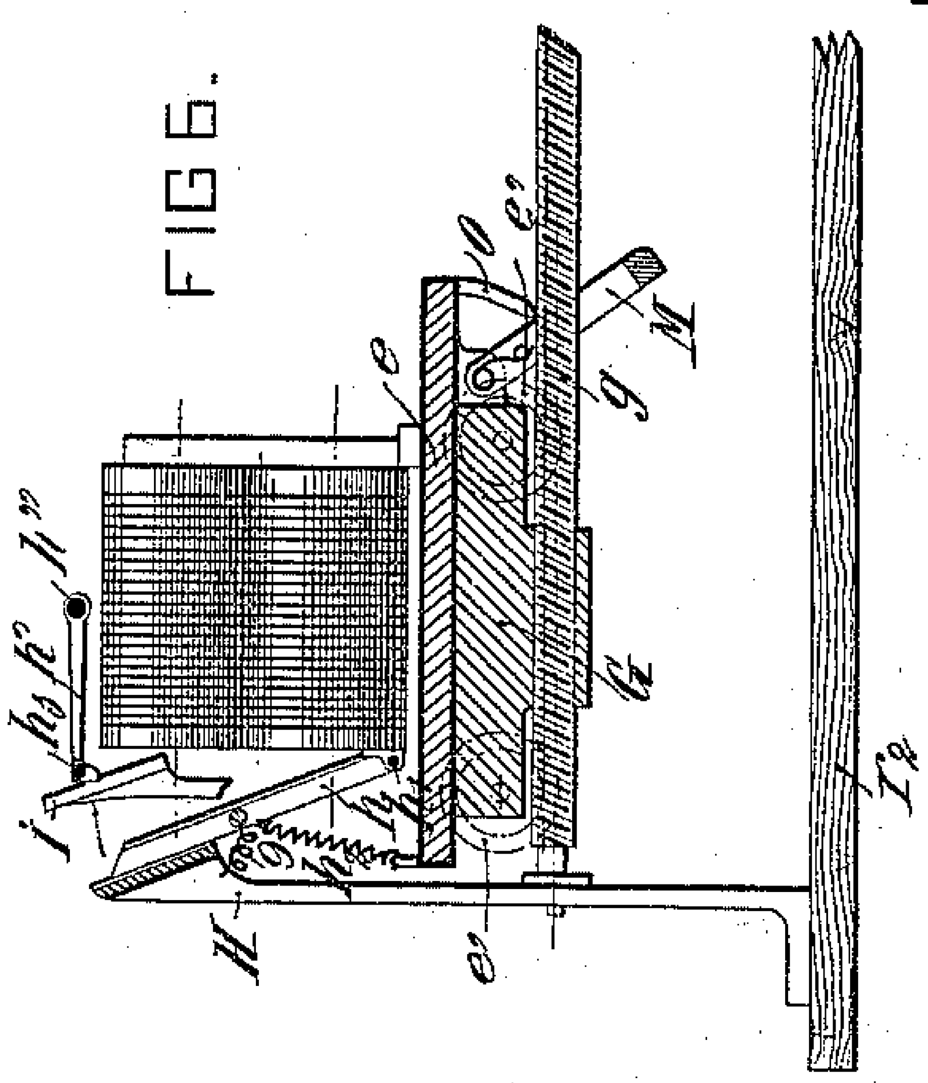
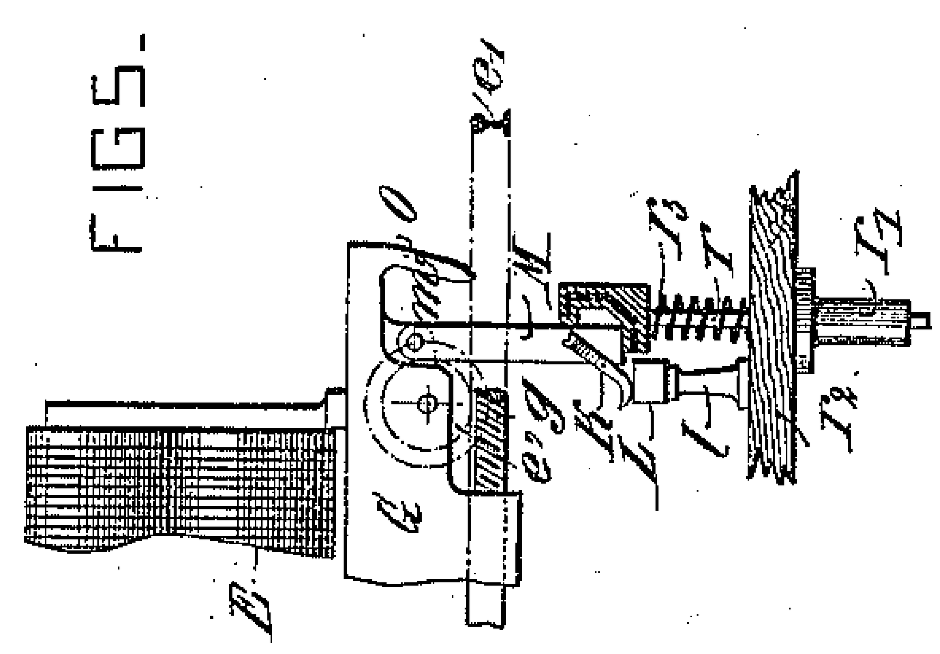


FIG 5.



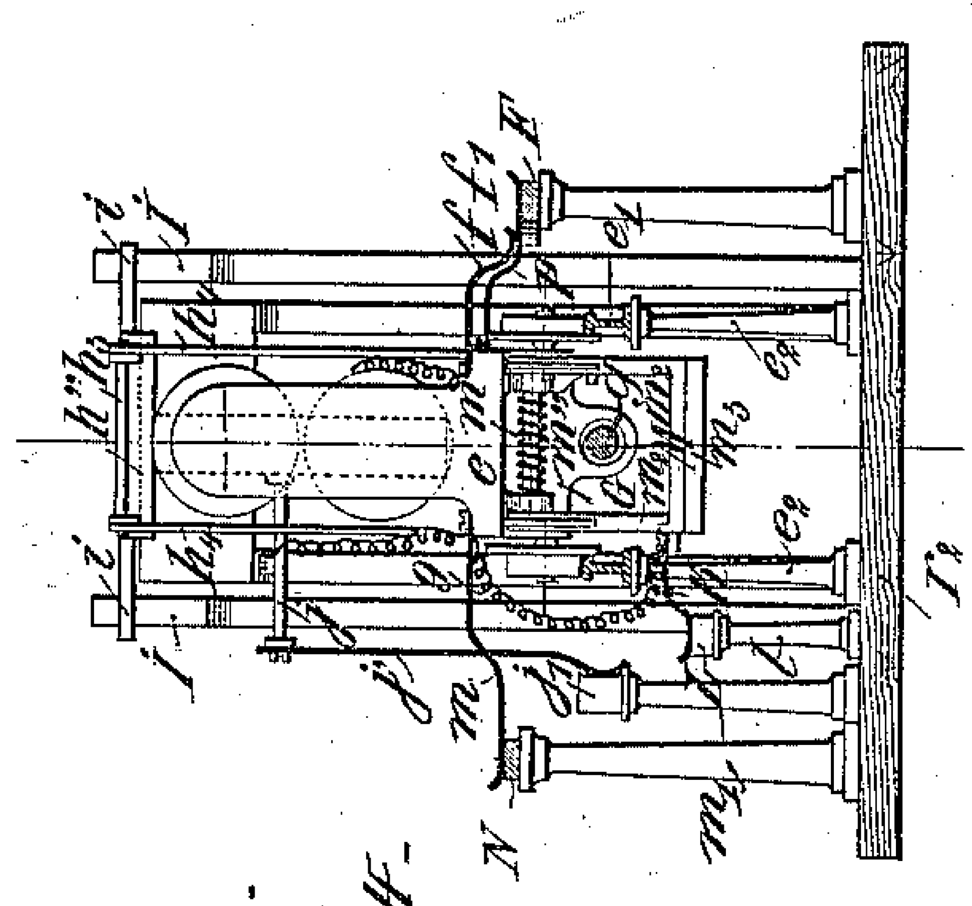


FIG 3.

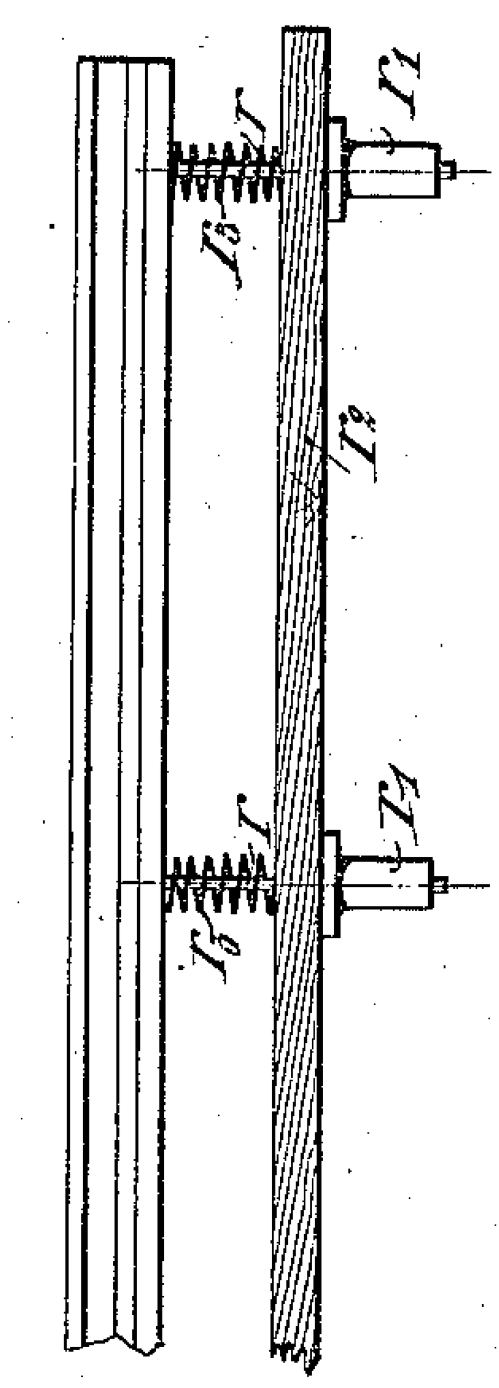


FIG 4.

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M. FREUDENBERG.

AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

No. 556,007. Patented Mar. 10, 1896.

FIG. 7.

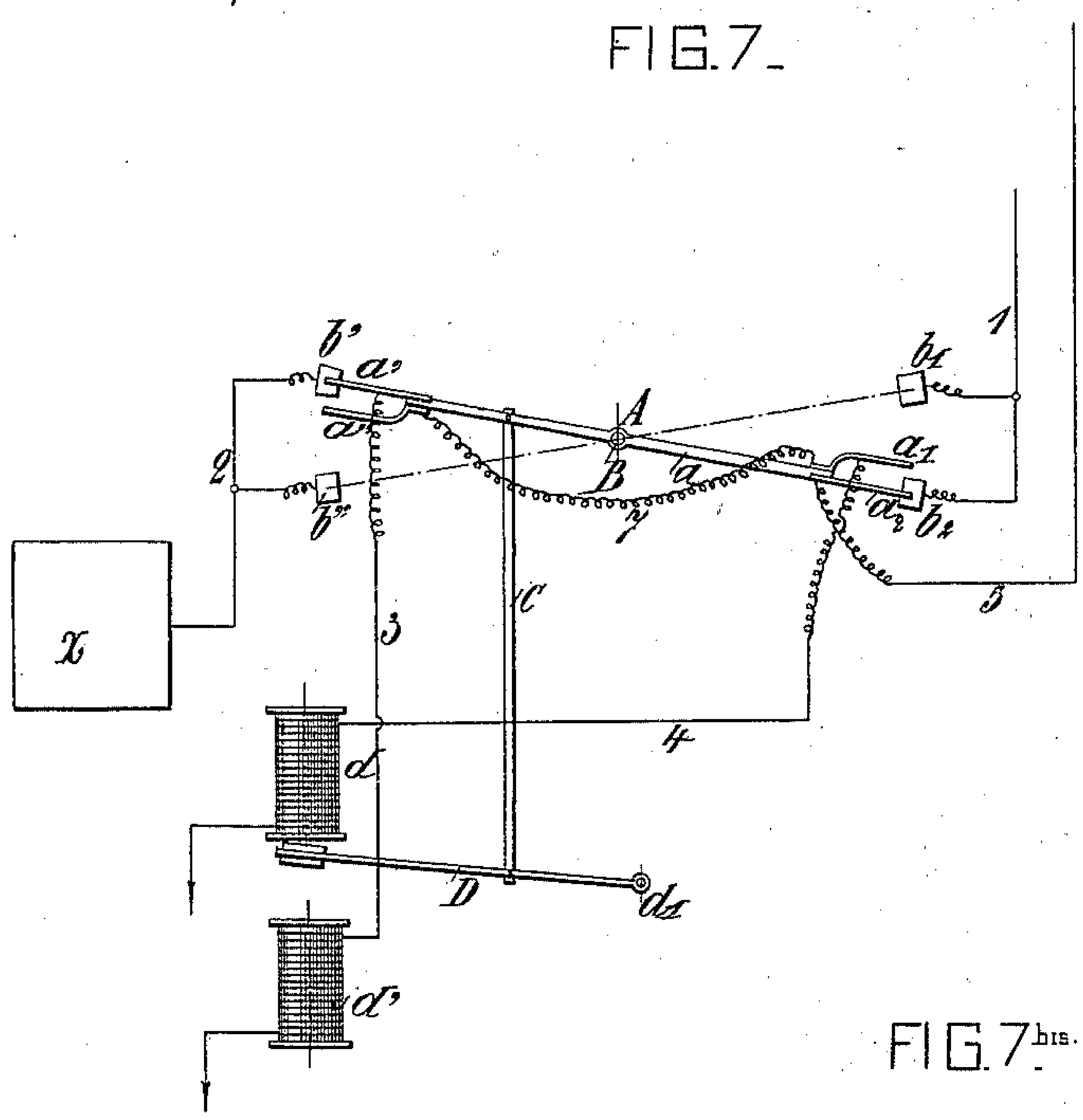
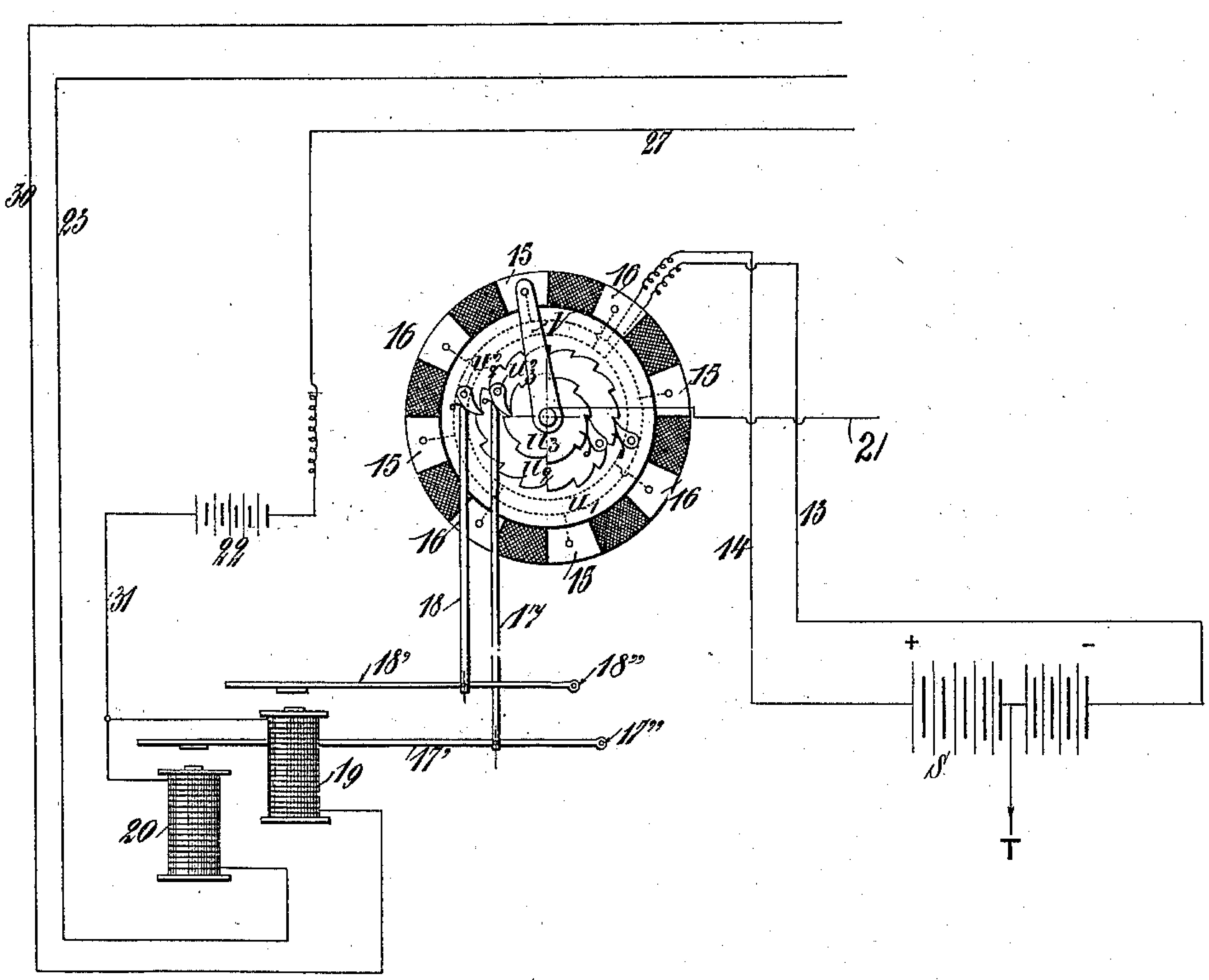


FIG. 7 bis.



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M. FREUDENBERG.

AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

No. 556,007. Patented Mar. 10, 1896.

FIG. 8.

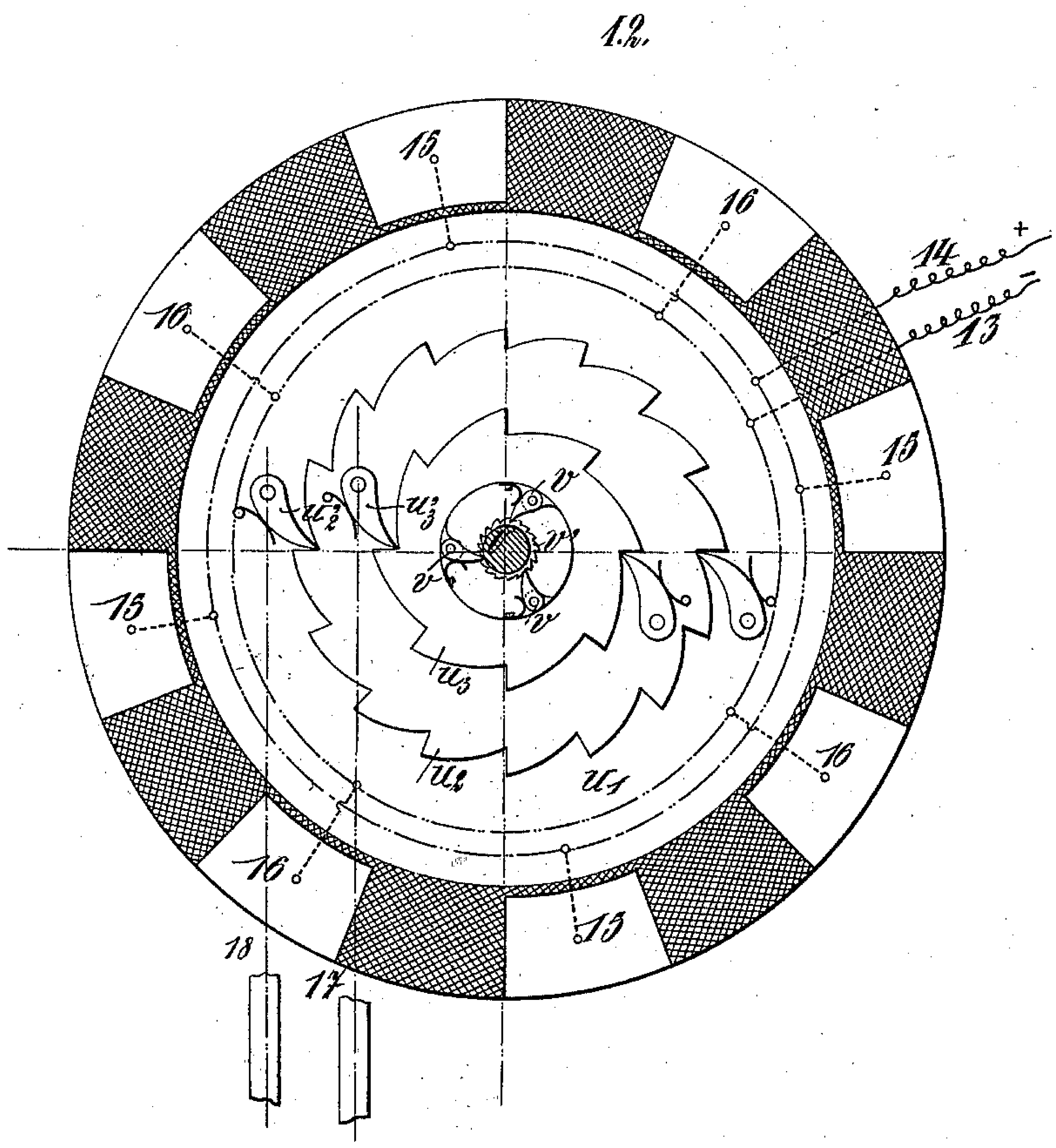
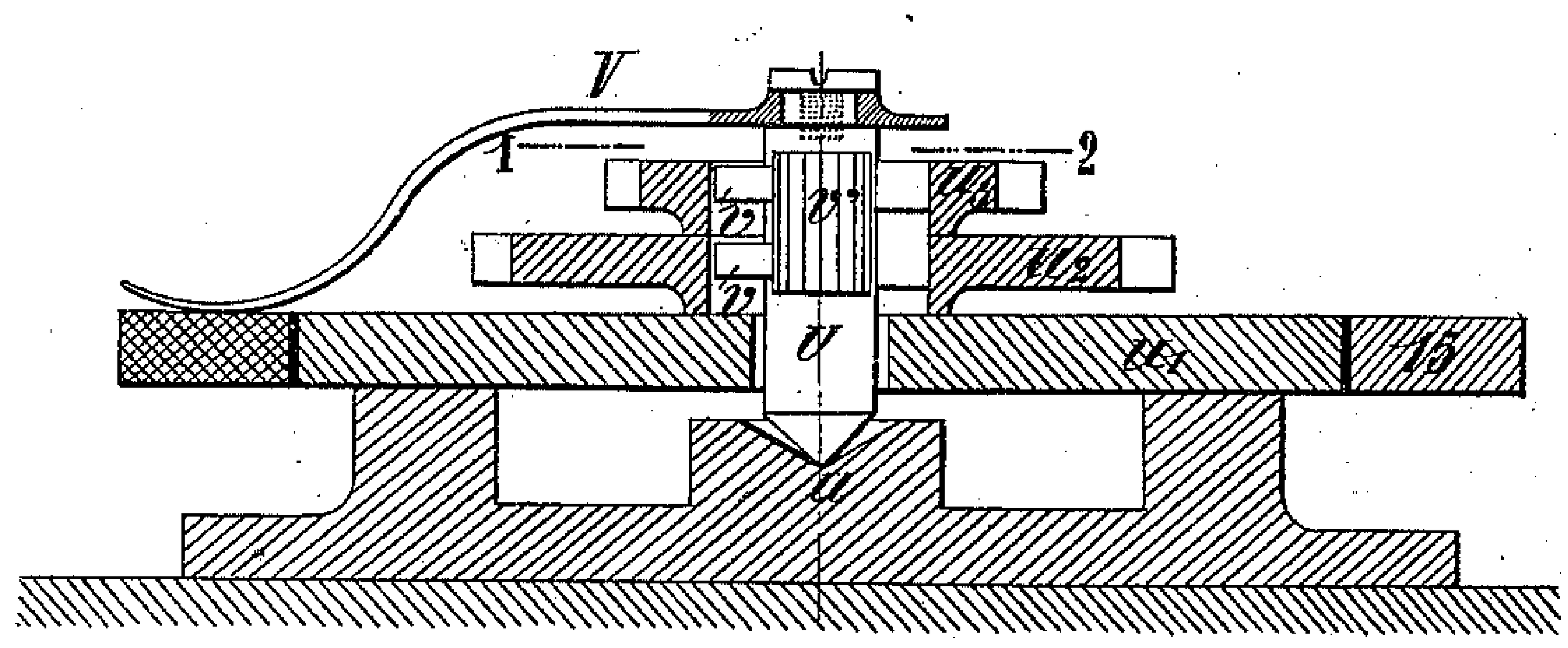


FIG. 9.



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AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

No. 556,007. Patented Mar. 10, 1896.

FIG. 11.

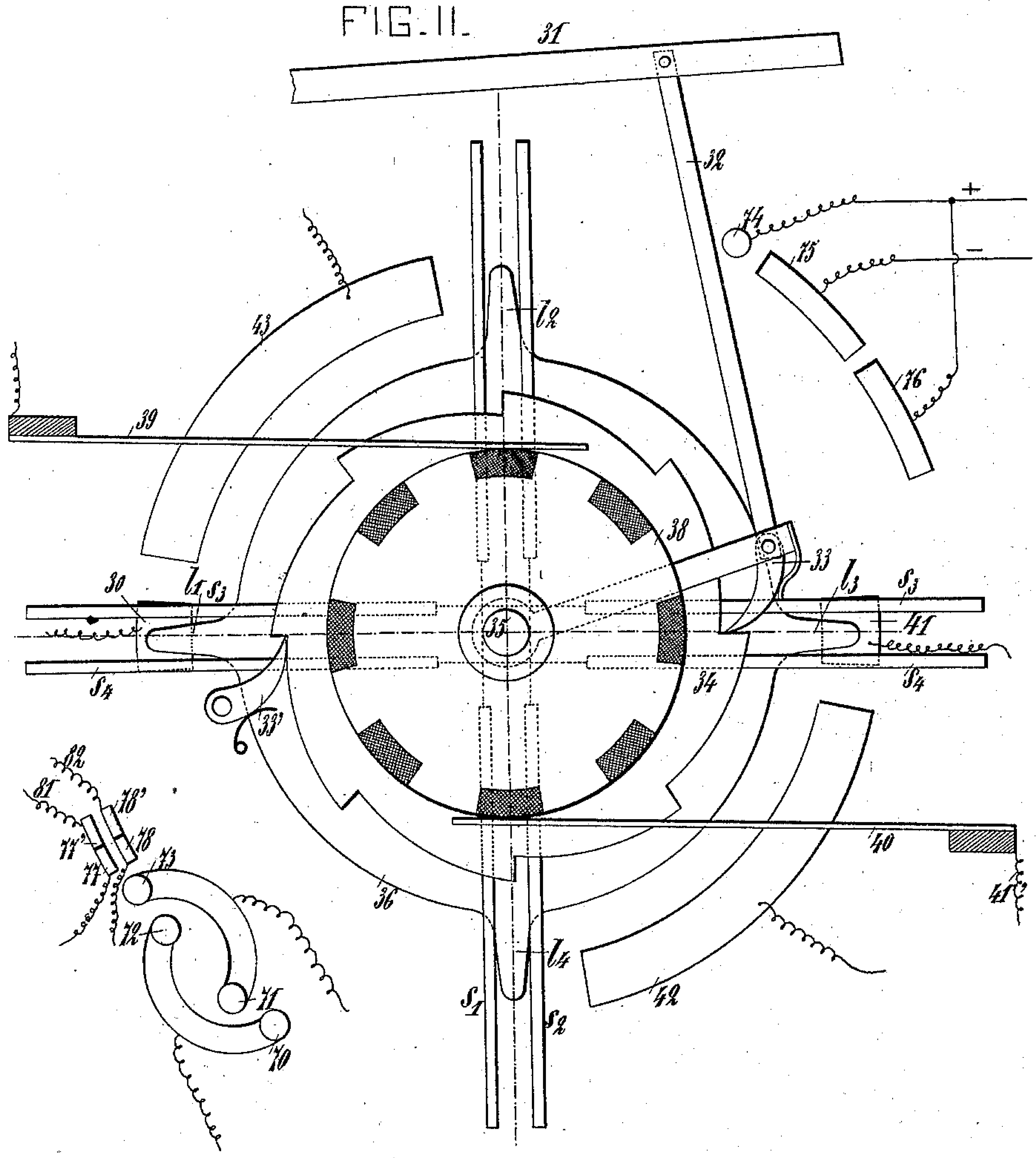
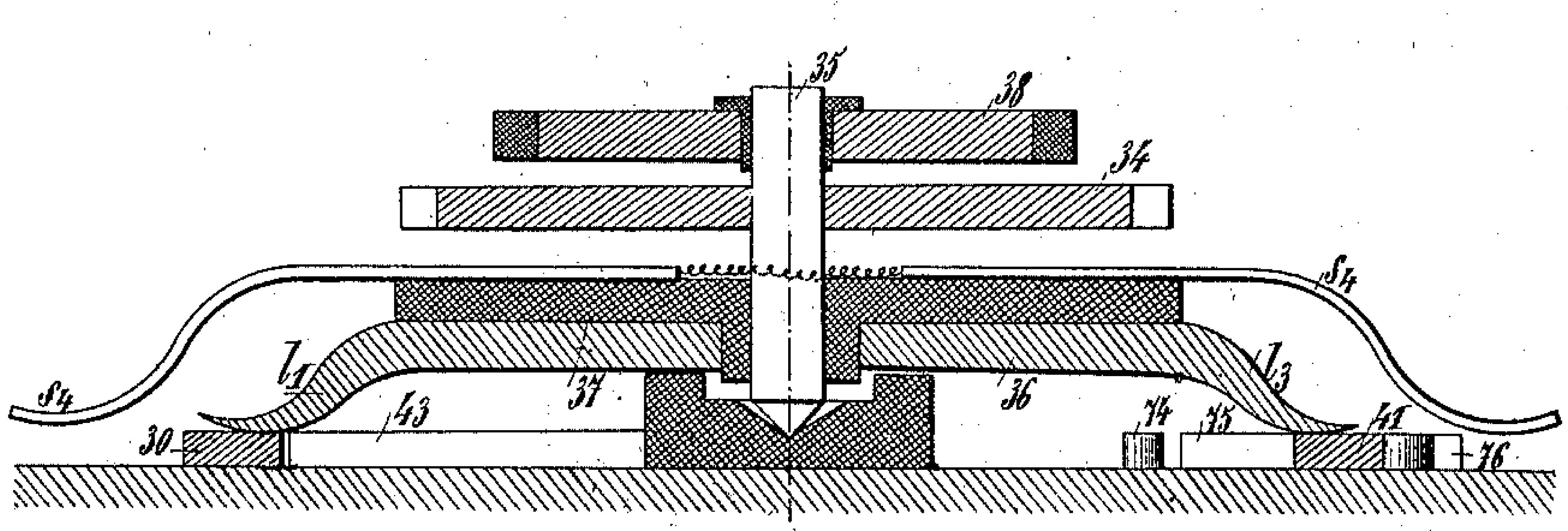


FIG. 10.



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(No Model.) 7 Sheets—Sheet 6.

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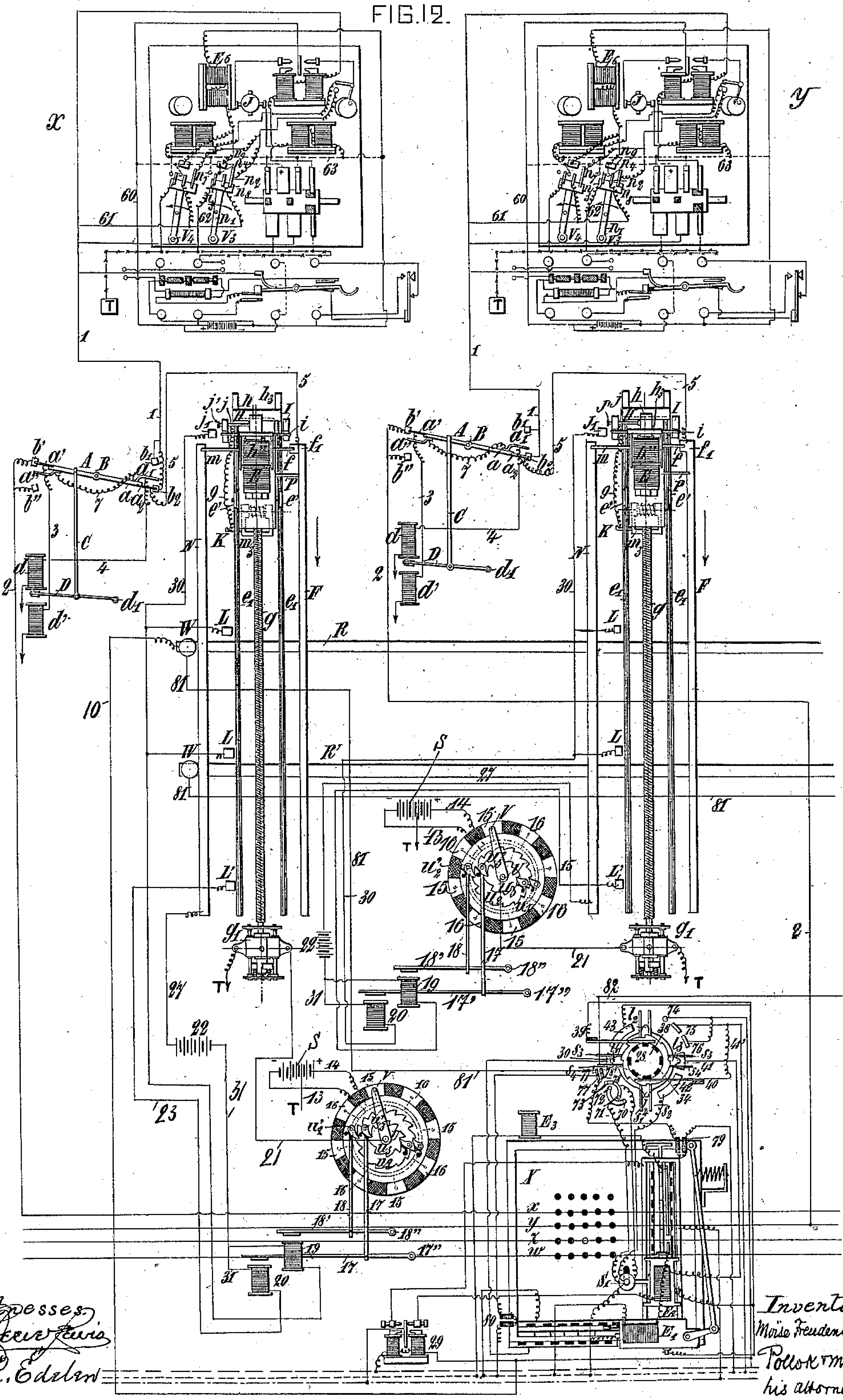
AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

No. 556,007. Patented Mar. 10, 1896.

FIG. 12.



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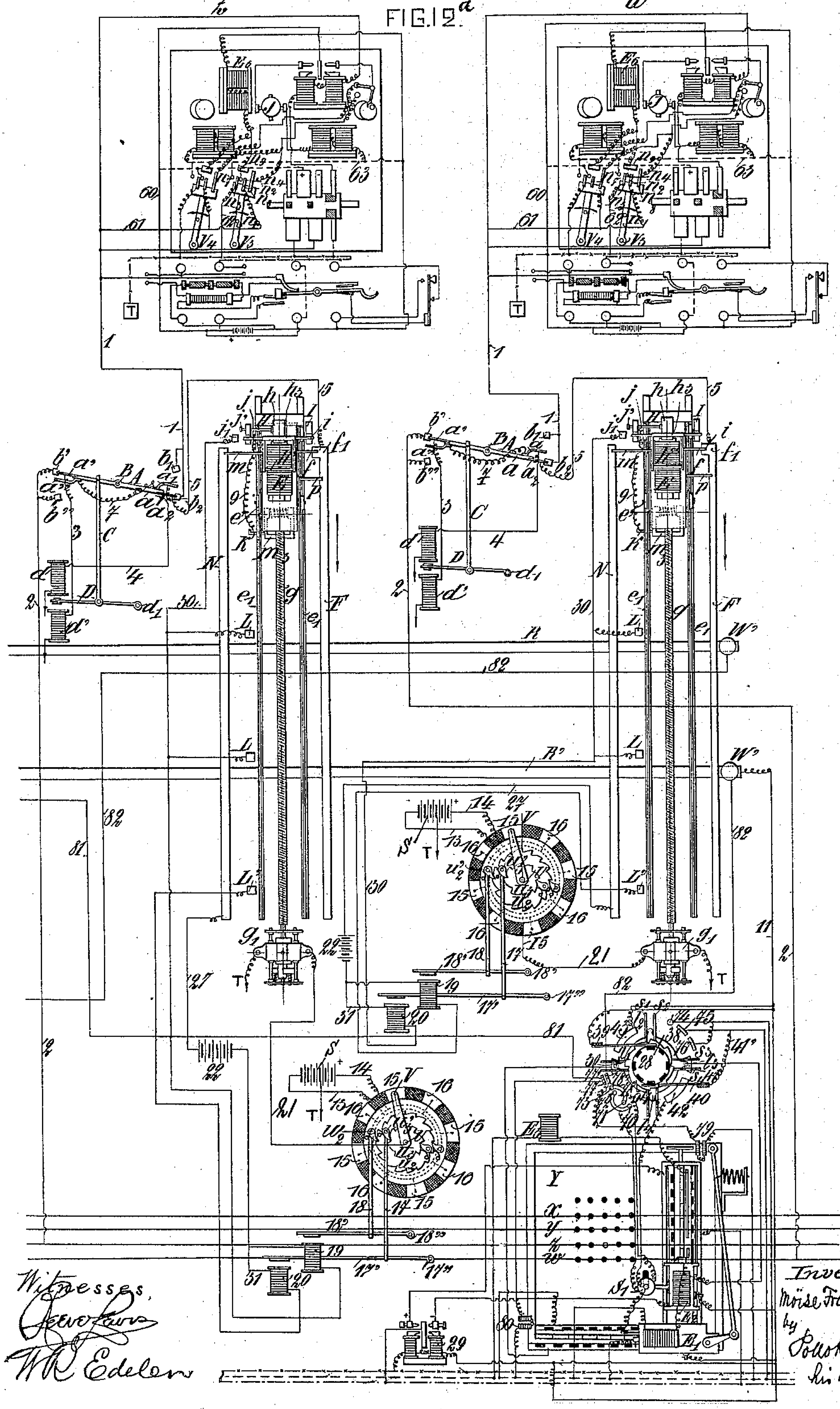
AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

No. 556,007. Patented Mar. 10, 1896.

FIG. 12ª



Witnesses,
George Lawis(?)
W. R. Edelen

Inventor.
Moïse Freudenberg
by Pollok & Mauro
his attorneys

UNITED STATES PATENT OFFICE.

MOÏSE FREUDENBERG, OF PARIS, FRANCE, ASSIGNOR TO ROGER WILLIAM WALLACE, OF LONDON, ENGLAND.

AUTOMATIC TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 556,007, dated March 10, 1896.

Application filed January 10, 1896. Serial No. 574,934. (No model.)

To all whom it may concern:

Be it known that I, MOÏSE FREUDENBERG, of Paris, France, have invented certain new and useful Improvements in Automatic Telephone-Exchange Systems, as fully described in the following specification.

This invention relates to improvements in telephone systems.

As is well known, the telephonic communications between the subscribers of a telephone system are at present obtained by the medium of special officials or attendants posted at the central or district stations and whose duty it is to establish the communications according to the instructions given to them by the subscribers.

In a prior patent I have described a telephonic self-communicating system which allows any subscriber to place himself automatically in communication with any other subscriber without necessitating the intervention of special attendants and irrespective of how large the number of subscribers of the system may be.

The present invention relates to certain improvements which I have applied to this automatic telephone system with the object of simplifying the function of the apparatus and of diminishing for one and the same number of subscribers the number of plates arranged at the central station.

According to the invention described in the specification of the prior patent, No. 546,725, of 1895, granted to myself and to Salomon Berditschewsky, for each subscriber at the central station one plate is provided upon which as many metallic contacts are arranged as the system has subscribers. It follows therefrom that a system of, say, eight thousand subscribers is provided with eight thousand plates at the central station. In my new system this number of plates is considerably reduced and is only equal to what we may term the "maximum regime" of the system, by which I mean a number equal to the maximum number of conversations taking place at the same time. Let us take an example in order to render this definition clearer.

Suppose a system of eight thousand subscribers. Suppose that it has been found that in no case more than six hundred conversations take place simultaneously in the system. Then the maximum regime of the system will be equal to six hundred. This regime evidently varies according to the countries, towns, and districts in which the system is located. Taking this as granted, and before entering into the thorough study of my new system, I shall first of all explain the principle upon which the same is based. Each subscriber has at his place an instrument, otherwise called a "subscriber's post," very nearly similar to that which I have described in my prior automatic-telephone patent, and the wire which passes from each subscriber's local instrument ends at the central station in a carriage or wagon which is capable of being displaced above a certain number of beams or levers. Each of these beams or levers is connected by a wire to a contact-plate which is identical to that of my automatic telephone system, and which is consequently provided with a number of contacts equal to that of the subscribers. The contacts of subscribers in all the plates are united by a wire to the movable carriage or wagon which corresponds to the said subscriber, so as to be connected to the line which passes from the subscriber's instrument to the carriage or wagon.

Any subscriber desirous of entering into conversation with any other subscriber of the system causes the carriage or wagon in which his conducting-wire of the line terminates to be displaced by the passage of a current, until this carriage or wagon is thrown in contact with a beam or lever, the result of which is to allow the subsequent currents sent by the subscriber to arrive at that plate which is connected to the beam or lever. On then operating as described in the aforesaid specification the subscriber can pass the pin of the plate upon that contact which corresponds to the subscriber with whom he wishes to be placed in connection, and thus the communication between the two subscribers is established.

As will be seen, the economy of my new system consists in having a limited number of plates, each of which corresponds to a beam instead of corresponding to a subscriber, as in my prior patent. To sum up what I have stated: in my new application there are as many movable carriages as there are subscribers and a number of beams and plates equal to what I have termed hereinbefore the "maximum regime" of the system.

Having thus explained the principle upon which my new telephone apparatus is based, I will proceed to describe in detail all the arrangements which I have contrived for putting this apparatus into practice, without, however, again describing those arrangements which are already employed in the automatic telephone system described in my prior patent.

In order to render these following explanations as clear as possible I have represented my new automatic telephone system, as an example, in the accompanying drawings, in which—

Figure 1 is a longitudinal view of a wagon or carriage and the rails or track on which it moves, the same being located at the central office and connected with the subscriber's line-wire. Fig. 2 is a plan view thereof, and Fig. 3 a transverse section on the line 3 4 of Fig. 1, looking in the direction of the arrow. Fig. 4 is a detail view of one of the beams or levers with which the carriages can be brought into contact. Fig. 5 represents in detail the front of a carriage or wagon, showing the same in contact with a beam or lever. Fig. 6 is a detail view showing the carriage at rest at the terminus of its track. In this figure certain parts of the carriage are omitted in order to show more clearly the electromagnet and the movable plate which are arranged on the carriage. Fig. 7 is a plan view of a special switching device which is inserted in the circuit of the line-wire of each subscriber, and which is arranged at the place where the line-wire enters the central station. Fig. 7^{bis} is a diagrammatical plan view of the switching device or commutator which is placed at the side of each carriage or wagon and controls the motor or dynamo which produces the displacements of the carriage or wagon, as I shall explain hereinafter. Figs. 8 and 9 are a plan and sectional view, respectively, representing the constructional details of this switching device or commutator. Figs. 10 and 11 are a plan and a sectional view, respectively, of the commutator or switching device which is placed upon each plate at the central station. Figs. 12 and 12^a are diagrammatic views of a telephonic installation according to my improved system, each figure showing two subscribers' apparatus as connected with the central-office apparatus.

I will divide the explanation of my apparatus in the following manner: first, the description of the apparatus arranged at the subscriber's station, of the carriage and of its track, of the beams and of the auxiliary mechanisms; second, the description of the switching device at the central station; third, the operation of the apparatus when taking as an example the system of four subscribers, as diagrammatically represented in Figs. 12 and 12^a of the drawings.

In the apparatus arranged at each subscriber's place the same mechanisms are provided as in my prior patented apparatus, and we find therein also the four buttons or knobs V^1 V^2 V^3 V^4, the effects of which I will repeat herein. Pressure upon the button or knob V^1 causes a series of positive currents to be sent over the line. Pressure upon the button or knob V^2 causes a series of negative currents to be sent over the line. In the previous apparatus these positive and negative currents produced the displacement of the carriage from the plate following the line of the abscissæ and that of the ordinates. They have the same effect in the present apparatus, as I am going to explain hereinafter when describing the function of the apparatus. The buttons or knobs V^3 and V^4, which, in my previous apparatus were employed to produce a series of positive and negative currents, cause simply two positive currents to be passed, one of them produced by the button or knob V^3 and the other by the button or knob V^4.

As indicated in Fig. 12, the buttons or knobs V^3 and V^4 are arranged in the following manner: The button or knob V^3 actuates a rod n^1, which can turn on a pivot. At the extremity of the rod n^1 three fingers or projections n^3, n^2, and n^8 are arranged, which, when the knob or button is acted upon, can be respectively placed into contact with the three metallic plates n^4, n^7, and n^9. The plate n^4 is connected by the wire 60 to the positive pole of the battery and the finger or projection n^2 is connected to the line-wire 1 through the wire 61. Consequently a positive current passes from the subscriber's apparatus, arrives at the central station, where it produces the effects which I am going to explain hereinafter, and passes back through the earth, the wire 62, the finger n^3, the plate n^7, and returns through the wire 63 to the negative pole of the battery. The contact of the finger n^8 and of the plate n^9 is utilized, as in my previous apparatus, for completing the circuit of the electromagnet E^6, which is actuated by the controlling-current automatically sent through the plate of the central station to the subscriber's apparatus.

The arrangements for the button V^4 are absolutely identical and apart from the modifications which I have just mentioned. The apparatus or post of the subscriber is the same as that fully described in the aforesaid specification, and in this description I shall not again describe all the constructional details of this instrument.

The wire of the line 1 which starts from the subscriber's instrument arrives at the central station at the terminals b^1 and b^2 of the switch A, Fig. 7. This switch is composed of a rod a, terminating at each of its extremities in two spring-blades a' a'', a^1 a^2. The rod a is movable around the pivot B and the length of this rod is so calculated that the same is enabled to occupy the two following positions:

First. The position represented in Fig. 7, in which the blades a' and a^2 are respectively in contact with the plates b' and b^2. This is the position which the switch occupies when the instrument of the subscriber in question does not operate or when this subscriber enters into communication with another subscriber.

Second. The position in which the blades a'' and a^1 are respectively in contact with the plates b'' and b^1, this being the position which the switch takes up when any subscriber enters into communication with that subscriber to whom the switch belongs.

The rod a of the switch is connected by a connecting-rod C to a plate D, which latter is pivoted at one of its extremities, d^1, while its other extremity is adapted to move between two electromagnets d and d'.

When a current traverses the electromagnet d, the plate D will be attracted and the rod a of the switch will take the position which it occupies in Fig. 7. If, on the contrary, a current traverses the electromagnet d', the plate D will be attracted by this latter electromagnet and the rod a of the switch will take the second position which I have defined hereinbefore.

In no case, as I shall explain hereinafter when describing the communications, can the two electromagnets be traversed by a current at the same time.

As I have said hereinbefore the plates b^1 and b^2 of the switch are connected by the conducting-wire 1 to the instrument of the subscriber. The plates b' and b'' are connected by the wire 2 to the metal band or strip which is placed beneath the plates X Y and which in each of these plates has a contact at the point in which each subscriber's abscissa and ordinate meet.

The blade a', Fig. 7, of the switch A is insulated from the rod a and is connected by the wire 3 to the electromagnet d'. The blade a'', Fig. 7, of the switch A is insulated from the rod a and is connected by the wire 7 to the blade a^1 of the same switch. The blade a^1 is likewise insulated from the rod a and is, moreover, connected by the wire 4 to the electromagnet d. The blade a^2 of the switch A is insulated from the rod a and is connected by the wire 5 to the band F parallel with the track for the carriage or wagon upon which the electromagnet E, Figs. 1, 2, and 3, is mounted.

The carriage or wagon, Figs. 1, 2, 3, 5, and 6, is composed of a platform e, which is mounted upon friction-rollers e' and which supports the electromagnet E. The friction-rollers roll upon two parallel rails e^1, Figs. 1, 2, and 3, placed at the required distance apart and maintained by supports e^2.

The carriage or wagon carries at its lower part and between the rails an internally-screw-threaded socket G, Figs. 1 and 3, in which the screw g, Fig. 2, engages. This screw can be actuated by a rotary movement upon itself by the motor or dynamo g^1 placed at the extremity of the track e^1.

As will be easily understood, the effect of the rotary movement of the screw is to produce the displacement of the carriage or wagon upon the track e^1, and the direction of the displacement of the carriage evidently depends upon the direction in which the screw is rotated.

The electromagnet E is of course insulated upon the carriage, and the wire which is wound upon this electromagnet is connected at one end to earth and on the other hand to the spring-blade f, Figs. 2 and 3, which rubs upon the widened part f^1 of the band or strip F. The widened part f^1, as is seen in Fig. 2, only exists upon a very slight length of the band or strip F at one extremity thereof. As soon as the carriage is set in motion, the blade f leaves the part f^1 of the band or strip F and does not come again into contact until the carriage has returned to its starting-point. When the electromagnet E is traversed by a current, it attracts the plate h pivoted at h^1, Figs. 1 and 6, upon the platform. Normally—that is to say, when the carriage or wagon is not moving—the plate h rests against the support H under the action of the spring h^2, Figs. 1 and 6.

Above the electromagnet E a frame is arranged, composed of two parallel rods h', Fig. 6, a hinge or pivot h'' and a rod h^3, the section of which has the form of a hook, Figs. 3 and 6.

The axis of rotation h'' of the frame is supported by the two standards h^4 h^4, Fig. 3, which rest upon the platform e. The rod h^3 carries at each side a prolongation i, and when the carriage is at rest at the extremity of its path the two prolongations i i rest upon the two fixed inclined planes I I, Figs. 3 and 6, and in this position the frame is kept horizontal, as indicated in Fig. 6.

As soon as the carriage is displaced, the prolongations i i slide along the inclined planes I I and the hook h^3 is lowered and will keep the plate h against the electromagnet E, which plate, as we will see hereinafter, had been attracted by the electromagnet at the moment when the carriage or wagon was set in movement.

Upon one of the lateral surfaces of the plate h is fixed a horizontal rod j, from which a spring-blade j', Figs. 1 and 3, is suspended. The lower extremity of this spring-blade rubs against a contact j^1 when the plate h is attracted by the electromagnet E. The rod j and the spring-blade j' are insulated from the plate h and are connected by the wire 9 with a blade K, which is secured to but insulated from a frame M, Figs. 1 and 3, placed at the front part of and below the carriage or wagon. I will describe hereinafter the arrangements of this frame.

The blade K serves, as I am going to explain in detail, to enter at certain moments during the displacement of the carriage into contact with the metal plates L, supported by the posts l. The wire 9 which connects the blade K to the rod j and to the spring j', Fig. 3, is likewise attached to a blade m, fixed to but insulated from the platform e. During the displacements of the carriage the blade m rubs upon the band or strip N supported by the standards, parallel to the rails e^1 and e^1.

The frame M, of which we have spoken hereinbefore and upon which the blade K is fixed, is arranged in the following manner: The same is composed of two parallel rods m^2 m^2, Fig. 3, united in front by a metallic cross-rail m^3. The frame M can turn around the axis m', around which is wound a spring m'' which constantly tends to lift the frame M and to bring the same against the abutment O fixed to the front of the carriage. In this position the frame is inclined with regard to the carriage, as indicated in Fig. 1. The cross-rail m^3 is electrically connected by the bars m^2 to the platform e of the carriage or wagon, upon which is fixed, without interposition of insulating material, the spring-blade P, Fig. 2, which during the displacements of the carriage remains constantly in contact with the band or strip F, connected by the wire 5 to the blade a^2 of the switch A, Fig. 7.

Below the rails and at distances apart beams R R' are arranged. In the example of the drawings I have only supposed that there are two, but this number depends, as I have shown in the beginning of this description, upon the maximum regime of the system. These beams are arranged horizontally and perpendicular to the direction of the rails e^1. The beams extend below all the tracks which comprise the system or rather the group of a system under consideration, for in order not to give these beams too great a length all the carriages or wagons may be connected with one and the same system in several groups, which may be placed either at the central station or in stations which would correspond to what are at present usually called "district stations." Each of these beams can be composed, as indicated in Figs. 1, 4 and 5, of an upper bar hollowed upon that side of the bar which is turned toward the starting-point of the carriage. The said beam is provided with supports r at distances apart, Fig. 4, which supports are connected with guides r^1 supported by a fixed beam r^2 serving as a frame. Springs r^3 constantly tend to press the beam proper away from the frame r^2, and this upper beam remains constantly parallel with the frame r^2 owing to the rods r which, while engaging with the guides r^1, prevent any inclination of the beam. The upper hollowed-out part of each beam is made of or coated with metal and is provided at one of the extremities of the beam with a terminal r', Fig. 2, to which a wire 10 is connected, which ends in that plate of the central station which corresponds to the beam. If we consider Figs. 12 and 12ᵃ, it will be seen that the beam R is connected to the plate X by the wire 10, and the beam R' is connected by the wire 11 to the plate Y. If we compare this new arrangement with the apparatus which forms the object of my said prior patent, one may say that the wires 10 and 11 play here the part of the former line-wires of the subscribers and terminate in the plates X Y at the same point.

If we suppose for a moment that any one of the parallel carriages which can be displaced above the beams (one carriage corresponds to one subscriber) is set in motion, it will arrive near the beam R, and the frame, or, speaking more exactly, the cross-rail m^3 of the frame, will rest in the hollow of the beam R. As the carriage cannot rise above its rails, (owing to the use of any appropriate system of upper or guard rails, which for the sake of clearness are not shown in the drawings,) the beam will descend in proportion as the carriage continues to advance. When the beam has thus been lowered, the carriage, as I shall explain hereinafter, stops by itself, and if another subscriber causes the displacement of his carriage by sending a current he will not be able to place the same in contact with the already-occupied beam, since this latter is lowered. We will see hereinafter the usefulness of this arrangement; but I may here remark that the arrangements of the beam for the purpose of causing the same to be lowered by the contact of the carriage may greatly vary and that the one which I have described herein is merely given as an example.

The displacements of each carriage are obtained, as I have explained, by a motor or dynamo, (each carriage having a separate motor,) and I will now describe the arrangement which I have adopted for producing the movements of the motor in either direction.

For facilitating the understanding of the description I have supposed that the electric motor, which in the example is a small dynamo, would act with one single wire—that is to say, that the return flow of the current to the battery would take place through the earth. In practice this arrangement cannot be realized, because there are no such electromotors yet in existence which act satisfactorily under these conditions; but this defect may be remedied by modifying the commutator which actuates each dynamo, and which I am going to describe, in such a manner as to insert the motor in a closed circuit.

The source of electricity is at S. The same is put into communication with the earth and its two poles are connected by the wires 13 and 14, Figs. 12 and 7ᵇⁱˢ, with a special switching device which is arranged in the following manner: The same is composed of a vertical shaft U, Figs. 8 and 9, capable of turning in a socket u. The vertical position of this shaft will be secured by any suitable upper support which I have not indicated. The shaft U passes loosely through an orifice made in the center of an ebonite or vulcanite bed-plate u^1, the periphery of which carries a series of metallic contacts 15, connected to one another and also connected to the positive pole of the battery S by the wire 14, and a series of metallic contacts 16 connected to each other and also to the negative pole of the battery S by the wire 13, Fig. 7^{bis}. These metallic contacts are arranged alternately and are separated by ebonite or vulcanite parts of the same width—that is to say, that on following the periphery of the bed-plate we find contacts in the following order: a portion or section of ebonite or vulcanite, a contact 16; a section of ebonite or vulcanite, a contact 15, &c. The number of contacts 15 is consequently equal to the number of contacts 16 and to one-half of the number of the insulating portions. The shaft U then passes into openings of a larger diameter than its own, these openings being provided in the centers of the ratchet-wheels u^2 u^3. The ratchet-wheel u^2 is provided with teeth twice as many in number as the ratchet-wheel u^3 possesses. Each ratchet-wheel is at its center provided with a hole for the passage of the shaft U, and upon the interior periphery of each of these openings three pawls v are fixed, placed at one hundred and twenty degrees apart from one another. These pawls are by means of appropriate springs kept constantly in contact with the teeth or grooves v', formed upon that part of the surface of the axis U opposite to the two ratchet-wheels u^2 and u^3. It follows therefrom that if the ratchet-wheel u^2 is caused to turn around one tooth the axis U will, under the action of the pawls v, turn upon itself to the extent of an arc equal to the thickness of one of the teeth or grooves thereon, since there are as many teeth or grooves arranged upon the axis U as there are teeth upon the ratchet-wheel u^2. This rotary movement will be without effect upon the ratchet-wheel u^3. On the other hand, if the ratchet-wheel u^3 is caused to turn one tooth the axis U will be turned to the extent of an arc equal to the thickness of two teeth or grooves v', since the ratchet-wheel u^3 carries half as many teeth as there are teeth or grooves upon the axis U. In this rotary movement the ratchet-wheel u^2 remains unmoved. It is thus evident that according to this arrangement it is possible to cause the axis U to be turned either by the ratchet-wheel u^2 or by the ratchet-wheel u^3, while the wheel which does not cause the movement remains unmoved during the rotation of the shaft U. Upon the exterior periphery of the ratchet-wheels u^3 u^2 the pawls $u^{3'}$ $u^{2'}$ are placed, which are kept constantly in contact with the teeth of the ratchet-wheels by means of appropriate springs. The pawl $u^{2'}$ is fixed to the extremity of a rod 18 connected to the plate 18′ pivoted at 18″. One of the extremities of this plate lies in front of an electromagnet 19, Fig. 7^{bis}. The pawl $u^{3'}$ is likewise fixed to the extremity of a rod 17 connected to the plate 17′, which turns on a pivot 17″. One of the extremities of this plate lies in front of an electromagnet 20. When a current is sent into the electromagnet 19, the plate 18′, being attracted, will turn on its axis of oscillation 18″, Fig. 7^{bis}, and consequently exert a pull upon the rod 18, and the pawl $u^{2'}$ fixed to the extremity of the rod 18 will cause the ratchet-wheel u^2 to turn to the extent of one tooth. The axis U, as I have explained hereinbefore, will itself turn under the action of the pawls v through an arc equal to the thickness of one of the teeth or grooves v', and during this movement the wheel u^3 will remain unmoved. If, on the contrary, the electromagnet 20 is traversed by a current, then the plate 17′ will be attracted and will turn about its axis of oscillation 17″, thus exerting a pulling action upon the rod 17. The pawl $u^{3'}$ fixed to the extremity of this rod 17 will cause the wheel u^3 to turn to the extent of an arc equal to the thickness of one tooth, and, as I have explained hereinbefore, the axis U will itself turn under the action of the pawls v through an arc equal to the thickness of two teeth, the wheel u^2 remaining stationary during this movement. It is thus evident that it is possible to impart to the axis U displacements which are equal either to the thickness of one tooth or groove v' or to the thickness of two teeth or grooves v'.

Upon the axis U a spring-arm V is fixed, Figs. 9 and 7^{bis}, which is adapted to rub upon the metallic contacts 15 and 16 and upon the insulating parts which separate these metallic contacts. The number of metallic contacts 15 and 16 and of insulating parts which separate these contacts is exactly equal to the number of teeth or grooves v' of the axis U and likewise to the number of teeth arranged upon the outer periphery of the ratchet-wheel u^2. It is thus evident that—if we suppose for a moment the arm V to be placed upon one of the contacts 15, as indicated in Fig. 7^{bis}, and if we send a current into the electromagnet 20—the axis U will, under the action of the ratchet wheel u^3, turn through an arc which is equal to the thickness of two teeth or grooves v' and the arm V, which was pressing upon the contact 15, will now press upon the following contact 16 after springing over the insulating part which separates these two consecutive contacts. If, on the contrary, we send a current into the electromagnet 19 while the arm V is upon the contact 15, as indicated in Fig. 7^{bis}, the axis U will, under the action of the ratchet-wheel u^2, turn through an arc equal to the thickness of a tooth or groove v', and consequently the arm V will become placed upon the insulating part which separates the contact 15 upon which it was resting from the contact 16 which immediately follows it. The arm V, which is insulated from the whole switching device, is connected by the wire 21 to the electromotor g'. If thus the arm V rests upon one of the insulating parts which separate the metallic contacts 15 and 16, no current will arrive at the electromotor. If, on the contrary, this metallic arm V rests upon a contact 15, a positive current coming from the battery S will pass through the wire 14 to the contact 15 upon which the arm rests. The current will then pass through the arm V and the wire 21 into the electromotor, which latter will revolve, for instance, from the left to the right. If instead of lying upon one of the contacts 15 the arm V rests upon the contact 16, a negative current will pass from the battery through the wire 13 into the contact 16, upon which the arm rests, and thence through the arm V and the wire 21 to the electromotor g'. This latter will thus revolve in the opposite direction—that is to say, from the right toward the left. The operation of the motor-switch is thus simply obtained by sending currents either into the electromagnet 19 or into the electromagnet 20. This sending of currents is effected automatically at the desired moment, as hereinafter described, by the movement of the carriage.

The electromagnet 19 is connected on the one hand to the local battery 22 and on the other hand to the contacts L and j^1, Fig. 2, through the wire 30.

The electromagnet 20 is connected on the one hand to the local battery 22 and on the other hand to the contact L', Figs. 2 and 7^{bis}, by the wire 23. The battery 22 is itself connected by the wire 27, Fig. 2, to the band or strip N parallel with the rails e^1.

Such is the complete description of the mechanisms which constitute each carriage corresponding to the apparatus of a subscriber, all carriages being arranged either at a district station or at the central station.

As hereinbefore stated, there passes from the switch A the wire 2, which terminates at the central station in the metallic band or strip which passes beneath the plates X and Y and which has, in each of these plates, a metallic contact having the abscissa and the ordinate corresponding to those connected to the subscriber's apparatus in question. On the other hand, as has been likewise stated, the beam R is connected to the plate X by the wire 10 and the beam R' is connected to the plate Y by the wire 11.

Before describing the complete function of the apparatus there remains to be mentioned the new arrangement which I have applied to the plates X and Y, and which were already provided in the apparatus described in the aforesaid specification. There is nothing altered in these plates X and Y except the arrangement of the special switching device 28—that is to say, that the plates are always provided with a double carriage E^1 E^2 capable of being displaced in two perpendicular directions, and which are caused to follow the line of the abscissæ by the passage of the positive currents and to follow the line of the ordinates by the passage of the negative currents. The different contacts on the plate X for producing these displacements in the two directions and for stopping at the desired moment the electromagnets of the carriage remain the same, and these different mechanisms are always connected in the same manner to the line-wires 10 and 11, which, instead of terminating, as in my former apparatus, at the subscribers' instruments, terminate actually at the beams R R'. As regards the switching device 28, the same is arranged in the following manner: It is composed of an electromagnet E^3, Fig. 12, which, when traversed by a current, causes a plate 31, Figs. 10 and 11, to be attracted, which plate carries an arm 32, at the extremity of which a pawl 33 is fixed, which can act upon the ratchet-wheel 34, keyed upon the axle 35.

When the attraction of the plate 31 takes place, the arm 32 while descending causes the pawl 33 to turn the wheel 34 in the direction in which the hands of a clock travel upon the dial, Fig. 11. A stop-pawl 33', forming a brake, regulates the rotary motion of the wheel 34 in such a manner that the same will turn through a distance equal to one tooth at each attraction of the plate 31.

Upon the axis 35, set in movement by the ratchet-wheel 34, are fixed:

First. A metal wheel 36, Fig. 10, insulated from the axis 35 and provided with four projections l^1 l^2 l^3 l^4, arranged at the extremities of two diameters at right angles to one another.

Second. An ebonite or vulcanite wheel 37, which carries four metallic rods s^1 s^2 s^3 s^4 forming two groups of two parallel rods, each group being perpendicular to the other. The extremities of these rods, which are bent down, can be displaced upon a series of contacts which are hereinafter described. The same is the case, on the other hand, with the projections l^1 l^2 l^3 l^4, firmly secured to the wheel 36, it being well understood that the extremities of the metal rods of the wheel 37 cannot touch the contacts upon which the projections l^1 l^2 l^3 l^4 are displaced, and that, vice versa, the projections l^1 l^2 l^3 l^4 cannot touch the contacts upon which the extremities of the said metal rods are displaced.

Third. The ratchet-wheel 34, of which I have spoken hereinbefore. This wheel is fixed directly upon the axis 35 without the interposition of insulating material. The same is provided with eight teeth.

Finally, right above the ratchet-wheel 34, but not in contact therewith, a disk 38 is arranged, the periphery of which is divided into sixteen parts, of which eight are metallic and eight of insulating material, the metallic parts alternating with the parts of insulating material. Upon the periphery of this wheel, at the extremities of one and the same diameter, two fixed brushes 39 and 40 make contact, one of which—namely, the brush 39—is connected to the line-wire which sets the relay electromagnet 29, Fig. 12, into communication with the corresponding beam, and the other of which, 40, is connected by the wire 41′ to the negative pole of the local battery, as in my patented apparatus.

When the ratchet-wheel 34 is at rest, the two brushes 39 and 40 press upon insulating parts of the disk 38, but when the ratchet-wheel turns the distance of one tooth, thereby carrying with it the disk 38, the brushes then press during this rotary motion upon metal parts of the disk in order to arrive subsequently again upon insulating parts.

Having thus described the different mechanisms which constitute my new telephone system, I will now proceed to describe the operation, while giving likewise the details of all connections established between the different mechanisms of which my system is composed. In order to facilitate this description I will refer to Figs. 12 and 12^a, in which I have represented the posts or apparatus of four subscribers $w\ x\ y\ z$. Each of these subscribers has his separate carriage or wagon, and these four carriages or wagons can be displaced above the two beams R R′, one of which acts upon the plate X and the other upon the plate Y.

In describing the operation of the apparatus, in order to distinguish the mechanisms which belong to the subscriber x from those belonging to other subscribers, I shall add to each reference-letter the letter "x" whenever I speak of a part or mechanism belonging to the apparatus of the subscriber x, and analogous I shall add the letter "y" to each reference-letter, designating a piece or a mechanism appertaining to the apparatus of the subscriber y, and so on; but, as for the sake of facilitating the explanation, I shall be likewise compelled, when describing the operation of the apparatus, to refer to the detail figures which I have previously used for explaining the arrangements adopted in my apparatus, which figures are not marked by the additional indications "x," "y," or "z," or "w." It is necessary to make it understood once and for all that the signs "x," "y," or "z," or "w" will exclusively serve for the description, the drawings having of course the same letters, but without the signs "x," "y," or "z," "w."

Let us suppose that the subscriber x wishes to enter into conversation with the subscriber z. The subscriber x will press upon the knob V′ in his plate, which knob was already provided in the apparatus described in the aforesaid specification, and while pressing upon this knob the subscriber x sends, as we have seen, a series of positive currents, which pass through the line-wire and thus to the plates b^{1x} and b^{2x} of the switch A^x, which latter is in the resting position—that is to say, in the position shown in Fig. 7. The positive current arriving in b^{1x} will have no action at all, because this plate is insulated; but the current also arrives in the plate b^{2x}, passes into the blade a^{2x}, and through the wire 5^x, and arrives in the metal band or strip F^x, parallel to the rails for the carriage upon which the electromagnet E^x is mounted. From this band or strip the current can take two directions. It can either pass through the platform e^x, through the blade P^x, or it can traverse the electromagnet E^x, through the blade f^x, since the two blades f^x and P^x are in contact with the metallic band or strip F^x. The current which enters the platform e^x has obviously no action whatever, since at this moment the only mechanism which is electrically connected to the platform—namely, the frame M^x—is not in contact with any of the beams; but, as the electromagnet E^x is connected to the earth, the current entering this electromagnet through the blade f^x will be enabled to pass through the earth to the subscriber's apparatus. Thus the circuit of the electromagnet E^x is completed, and this electromagnet attracts the plate h^x. While turning around its axis of oscillation h^{1x}, the plate h^x, from which the blade j'^x is suspended, will force this blade to rub against the contact j^{1x}, Fig. 3.

Let us now see what is the effect of the contact established between the metal piece j^{1x} and the blade j'^x. This blade is, as is hereinbefore described, and as is indicated in Fig. 3, connected through the wire 9^x to the blade m^x, which rubs upon the metallic band or strip N^x, Fig. 2, which latter is connected by the wire 27 to the battery 22, Fig. 12. On the other hand, the metal piece j^{1x} is connected by the wire 30^x to the electromagnet 19^x, which latter is on its part connected to the battery 22^x by the wire 31^x. At the moment that the blade j'^x and the metal piece j^{1x} make contact with one another the circuit of the electromagnet 19^x is closed. This electromagnet is thus traversed by a current, and the ratchet-wheel u^{2x} is turned to the extent of one tooth under the action of the pawl u'^{2x}. The arm V^x, which was previously resting upon an insulating portion of the wheel u^{1x}, is placed in contact with the metallic part 15^x, which follows immediately after the insulating part upon which the arm was previously resting before, and, as we have seen hereinbefore, this arm then completes the circuit of the motor g^{1x}, which is traversed by a positive current, which arrives from the battery S^x and passes through the arm V^x, the wire 21^x, and the motor. This latter consequently revolves from the left to the right and causes the screw g^x to turn, the effect of which, as I have hereinbefore explained, is to produce the displacement of the carriage in a forward direction, as indicated by the arrow in Fig. 12.

As soon as the carriage has been displaced to an amount equal to the length of the inclined planes I^x, upon which the prolongations i^x of the hook h^{3x} were resting, the said hook falls and holds the plate h^x applied against the electromagnet E^x, this taking place before the blade f^x has left the widening of the plate F^x, through which the electromagnet receives the current. The carriage therefore continues its displacing movement under the action of the motor-screw g^x, and a moment will be arrived at when the cross-rail m^{3x} of the frame M^x comes in contact with the beam R. As the carriage cannot become lifted upon its rails, and as the same is compelled to advance under the action of the motor-screw g^x, it is the beam R which becomes lowered, while the frame M^x turns around its axis of oscillation m'^x. In this rotary movement of the frame around its hinge m'^x the blade K^x fixed upon this frame rubs upon the metallic part L^x. Let us now examine the effect caused by the contact of the blade K^x with the metallic piece L^x, which is connected to the wire 30^x of the circuit of the electromagnet 19^x, and on the other hand the blade K^x is connected by the wire 9^x to the blade m^x, which rubs upon the band N^x.

At the moment of the contact of the blade K^x with the piece L^x the circuit of the electromagnet 19^x is closed, and, as previously, the arm V^x of the switch will be actuated and will place itself upon that insulating part which follows after the contact 15^x upon which it previously rested. By this movement of the arm V^x the circuit of the dynamo g^{1x} is opened, it stops, and consequently the carriage or wagon E^x likewise stops while maintaining the beam R depressed by the metallic frame M^x. The positive current sent by the subscriber when pressing the knob V^1 is thus enabled to pass now through the band or strip F^x, the blade P^x, the platform e^x, the frame M^x into the metallic part of the beam R and thence through the wire 10 into the plate X, and this positive current will not be able to follow any other course. If at the moment of the passage of the carriage over the beam R, this latter were occupied—that is to say, lowered by the carriage of the subscriber w, for instance—the carriage E^x would have continued its course, since the blade K^x would not have been enabled to rub upon the contact L^x. In continuing its course the carriage would have arrived above the beam R′, with which it would have been thrown in contact if this beam R′ were free, and what we have said hereinbefore from the point of view of the communications as regards the beam R evidently also applies to the beam R′, only the subscriber x, instead of utilizing the plate X for obtaining the communication with the subscriber z would have utilized the plate Y, since this latter is connected to the beam R′. If at the moment of the passage of the carriage E^x over the beam R′, this latter is in the depressed position—that is to say, occupied by another subscriber—the carriage E^x continues its course until the blade K^x rubs upon the metallic contact L'^x placed at the extremity of the rails or path of the carriage E^x.

Let us examine the effect produced by the contact of the blade K^x with the plate L'^x. This plate is connected by the wire 23^x to the electromagnet 20^x, which latter is itself connected by the wire 31^x to the battery 22^x, which terminates through the wire 27^x in the band or strip N^x upon which the blade m^x rubs, which latter is itself connected to the blade K^x, as we have already seen. The circuit of the electromagnet 29^x is thus completed by the contact of the blade K^x with the plate L'^x. This electromagnet attracts the pawl u'^{3x}, and the arm V^x, which was resting upon a metallic contact 15^x, will place itself upon the following metallic contact 16^x after having passed, without stoppage, the insulating part which separates the two contacts 15^x and 16^x. The rotary direction of the motor is thus abruptly changed, and the screw g^x, revolving in the contrary sense, forces the carriage to return. When arriving near the starting-point of the carriage the prolongations i^x, Fig. 3, of the hook h^{3x}, which latter maintained the plate h^4 against the electromagnet E^x, rise upon the inclined planes I^x, and the hook h^{3x} rises, thus leaving the plate h^x to itself. This plate, under the action of the spring h^{2x}, Figs. 3 and 6, is brought back against the support H^x while turning around its pivot h^{1x}. During this movement of the plate the blade j'^x, which is fixed to the plate by the rod j^x, rubs against the metallic contact j^{1x}, the effect of which, as before described, is to complete the circuit of the electromagnet 19^x, which latter is thus traversed by a current and actuates the ratchet-wheel u^{2x}. The arm V^x of the commutator or switch which was previously in contact with a metallic contact 16^x will place itself upon the insulating part which follows this contact. The motor will thus be stopped, as well as the carriage or wagon, which will thus have arrived at its starting-point.

As is evident from the preceding, there are three effects possible when the subscriber x sends a positive current through the line-wire for displacing the carriage E^x. First, the carriage E^x is hooked onto the beam R and stopped; second, the carriage E^x is hooked onto the beam R′ and is stopped; third, the carriage E^x is not hooked onto any beam and returns rearwardly to its starting-point, where it stops.

Let us suppose in the continuation of the description of the operation of our apparatus that this is the first effect that has taken place—namely, that the carriage or wagon E^x has become hooked onto the beam R.

In the plate X the positive currents will have the effect, as I have explained with regard to the apparatus described in the aforesaid specification, to displace the double carriage according to the line of the abscissa by sending to the subscriber's apparatus negative controlling-currents, which will cause figures to appear in the opening provided above the knob V^{1x}. When the figure which will appear to the eyes of the subscriber is equal to that which corresponds to the abscissa of the subscriber with whom he wishes to be set in communication, and which, in the example shown, has the abscissa 3, he will stop pressing the button V^{1x}, and by acting upon the button V^{2x} he will send a series of negative currents, the effect of which will be to displace the carriage E^{2x} along the line of the ordinates, and the effect of this displacement will be to send to the subscriber's apparatus positive controlling-currents, which will cause figures to appear in the opening provided above the knob V^{2x}. When the figure appearing to the eyes of the subscriber is that which corresponds to the ordinate of that subscriber with whom he wishes to enter into communication he will stop pressing the button V^{2x} and will then press upon the button V^{3x}. The effect of pressure on this knob V^{3x} in the present apparatus is entirely different from that which took place in the apparatus described in the aforesaid specification, and I will now proceed to describe it in detail.

The pressure exerted by the finger of the subscriber upon the knob V^{3x} has for its object to send, as hereinbefore stated, one single positive current into the plate X. This positive current cannot, for the same reason which I have indicated in my prior patent, act upon the electromagnets of the carriages E^1 E^2, but it can act upon the electromagnet E^3, which controls the commutator 28. Under the action of this positive current, which traverses the electromagnet E^3, the ratchet-wheel 34 turns through the distance of one tooth, thereby causing to turn with it the axis 35, Figs. 10 and 11, and consequently the wheel 36, as well as the wheel 37, which carries the switches s^1 s^2 s^3 s^4, arranged in perpendicular pairs, will likewise turn at the same time as the shaft 35.

Let us now consider the effect of this rotation corresponding to one eighth of a revolution, since the ratchet-wheel has only eight teeth. The projecting parts l^1 and l^3 of the wheel 36, which were at first in contact with the terminals 30 and 41, respectively, come into contact with the terminals 42 and 43, the effect of which, as in the apparatus described in my prior patent, is to disconnect the electromagnet of the carriage E^2. On the other hand, the terminal 42 is connected to the style S^1, which is displaceable upon the contacts of the plate, and the terminal 43 is connected to the line 11. Moreover, the rods of the wheel 37, during this former displacement, will press, on the one hand, upon the contacts 71 and 70, and, on the other hand, upon the metallic contacts 74 and 75. The contacts 71 and 70 are connected to the solenoid which surrounds the style S^1, whereas the contacts 74 and 75 are connected, one—namely, the metal contact 74, Figs. 10 and 11—to the positive pole of the battery, and the other—namely, the contact 75—to the negative pole of the battery. A current thus traverses the solenoid which surrounds the style S^1, and the action of this current causes the style S^1 to be applied against the contact above which the said style lies, and which, in the example shown in the drawings, is the contact of the subscriber z. It follows therefrom that the first rotation of the commutator 28 has this effect: to disconnect the electromagnet of the carriage E^2, to put the style in communication with the beam, which communication had been lost by the latter since the first displacement of the double carriage along the line of the abscissæ, and to strongly apply the style against the contact of the instrument of the subscriber z. This rotation has, moreover, the effect of sending a negative controlling-current to the instrument of the subscriber x through the wheel 38 and the brushes 40 and 39. This controlling-current arrives at the subscriber's instrument and traverses the electromagnet E^{6x}, the circuit of which is completed by the contact of the finger n^{8x} and of the plate n^{9x}. Thereby the disk or wheel J^x which is actuated by the electromagnet turns one-fourth of a revolution. The said disk or wheel, as shown and described in my patent aforesaid, carries near its periphery the words "Repos," (rest,) "Sonnez," (ring,) which repeat twice in the same succession. At the beginning, before a pressure upon the button V^{3x} is exerted, it is the word "Repos" (rest) which became visible to the eyes of the subscriber through the opening in his apparatus opposite the disk or wheel J^x; but as soon as this disk or wheel has turned one-fourth of a revolution under the action of the electromagnet E^{6x}, owing to the negative controlling-current produced by the rotation of the disk 38, the word "Sonnez" (ring) appears to the eyes of the subscriber, who is thus automatically informed about the position of the mechanisms of the plate X. He follows the indication and presses upon the ringing-knob, which sends a series of negative currents. These negative currents, following the way which we have indicated, arrive at the beam R and pass through the wire 10, the terminal 43, the projection l^1, the projection l^3, the terminal 42, and arrive at the style S^1. These currents thence pass into the contact of the subscriber z, upon which the style rests, and through the wire 2^z arrive at the terminals b'^z and b''^z of the switch A^z. This negative current cannot pass through b''^z, which is insulated, but passes through b'^z into the electromagnet d'^z, which is connected to the earth. The current thus returns through the earth to the subscriber's instrument and the circuit of the electromagnet d'^z is completed. This electromagnet is thus traversed by a current and attracts the plate D^z while turning the rod a^z of the switch, so as to bring the blades a''^z and a^{1z} respectively into contact with the terminals b''^z b^{1z}. The negative currents constantly sent by the subscriber x now pass to the switch A^z, no longer through the terminal b'^z, which has been insulated by the rotation of the rod a^z, but through the terminal b''^z, upon which the blade a''^z actually rests. The negative currents passing through the blade a''^{z} pass through the wire 7^{z} into the blade a^{1z} and through the terminal b^{1z} upon which the blade blade a^{1z} rests. The negative currents arrive at the instrument of subscriber z, where they cause the bell to ring. The subscriber z, thus informed by the bell that he is called to the instrument, applies the telephone to his ears and can instantly enter into communication with the subscriber x who has called him.

When the conversation is finished, the two subscribers x and z, who were engaged in conversation, both press the knob V^4 of their respective apparatus.

It is evident that the subscriber's instrument might be so combined that the action upon the knob V^4 would take place automatically when the telephone is rehooked onto the instrument.

Let us now consider the effect produced upon the mechanisms of the apparatus by the action of the knob V^{4z} of the apparatus of the subscriber z. The positive current, which, as we have seen, is produced by pressing this knob, since the mechanisms of the knob V^4 are identical to those of the knob V^3, passes through the wire 1^{z} and arrives at the terminal b^{1z} and through the blade a^{1z} in contact with the terminal b^{1z}. The current then arrives in the electromagnet d^{z}, the circuit of which is completed through the earth. This electromagnet attracts the plate D^{z}, the effect of which is to return the rod a^{z} into its initial position, thus returning all the mechanisms of the instrument of the subscriber z into the position which they have to occupy at the commencement of each communication—that is to say, returning all these mechanisms to what we might term their "zero" or "normal" positions.

We are now going to examine the effect produced by the positive current sent by the subscriber x when pressing the knob V^4 of his instrument. This current arrives in the plate X, as previously, through the band or strip F^{x}, the blade P^{x}, the frame or support e^{x}, the beam R and the wire 10. This current traverses the electromagnet-relay 29 which then completes the circuit of the electromagnet E^3. This latter is traversed by a positive current, which causes the attraction of the plate 31, and the pawl 33 causes the ratchet-wheel 34 to turn through the distance of one tooth, Figs. 10 and 11. The wheels 36 and 37 follow this movement and, consequently, effect a second rotary motion to the extent of one-eighth of a revolution, the effect of which we will now consider:

First. The rotary movement of one-eighth of a revolution of the wheel 36 brings the projections l^4 and l^2, Figs. 11 and 12, respectively in contact with the blocks 30 and 41, and consequently as the projections l^4 and l^2 are symmetrical to the projections l^3 l^1, the wheel 36 takes up the position which it occupied at the commencement of the communication, the same is thus returned to its zero position.

Second. The rotary movement of one-eighth of a revolution of the wheel 37 forces the two metallic rods s^1 s^2 to first rub upon the two blocks or contacts 72 73 by one of their extremities, and upon the contacts 75 and 76 by the other extremity. Now the blocks 72 and 73 are connected to the solenoid which surrounds the style S^1, and the metallic contact 75 is connected to the negative pole of the battery, Fig. 11, whereas the contact 76 is connected to the positive pole. It follows, therefore, that at the moment of the passage of the rods s^1 s^2 over the blocks or contacts 72 73, and over the contacts 75 and 76, the solenoid which surrounds the style S^1 is traversed by a current in contrary direction with regard to that which had traversed it for applying the style against the contact of the subscriber z. The style is thus lifted and takes up its place at that height which it normally occupies when it is to be displaced above the contacts of the plate X.

When continuing their rotary motion the rods s^1 s^2 rub on the one hand upon the blocks or contacts 77 and 78 and on the other hand upon the contact 76. The blocks or contacts 77 and 78 are connected to the electromagnets 79 and 80, Fig. 12, serving for the return of the carriages E^1 E^2, and the contact 76 is connected to the positive pole, and as the electromagnets 79 and 80 are connected to the negative pole of the battery a current is established which traverses the electromagnets 79 and 80, and the carriages E^1 and E^2 are returned to their starting-point. On continuing their rotary movement the rods s^1 s^2 pass over the contacts 77′ and 78′, which follow the contacts 77 and 78, but which are insulated therefrom, Figs. 11 and 12, and over the contact 76. Now the contact 77′ is connected by the wire 81 to the electromagnet W, placed at the one extremity of the beam R, and the contact 78′ is connected by the wire 82 to the electromagnet W′, placed at the other extremity of the beam R. At the moment when the rods s^1 and s^2 pass over the contacts 77′, 78′ and 76 a current traverses the electromagnets W and W′, the circuits of which are completed. This current, which traverses the electromagnets W and W′, produces the upward attraction of the beam R, and this latter while being raised forces back the carriage E^{x} very slightly, but to a sufficient extent so that the blade K^{x} will touch the contact L^{x}, which, as we before described, completes the circuit of the electromagnet 19^{x} of the commutator of the motor g^{1x}. The arm V^{x}, which was resting upon an insulting part, is placed upon the following metal contact, which is of necessity one of the metal contacts 16^{x}, producing the rearward motion of the carriage, since before its stationary period on the beam R the carriage E^{x} was moving forward, the arm V^{x} touching a metal contact 15^{x} causing the forward movement, and we have seen that upon the plate u^{1x} of the switch or commutator the metal parts are arranged in the following succession: first, a metallic part 15^x, connected to the positive pole of the battery, (forward movement;) second, an insulating part, (stopping;) third, a metal part 16^x, connected to the negative pole of the battery, (rearward movement;) fourth, an insulating part, (stopping,) &c. The carriage E^x thus returns rearwardly until it has arrived at the extremity of its course, where, as we know, it stops, owing to the contact of the rod j'^x and of the terminal j^{1x}, which contact, again completes the circuit of the electromagnet 19^x. It follows therefrom that all the mechanisms of the plate X, also those of the carriage of the subscriber x and those of the carriage of the subscriber z, have now returned to their starting-point. All the parts of the apparatus are therefore now at their zero or initial position.

There remains to be examined the effect produced by the negative controlling-current in the commutator 28 at the moment of the contact of the brushes 39 and 40 upon metallic parts of the wheel 38. This negative controlling-current arrives at the instrument of the subscriber x and traverses the electromagnet E^{6x}. The wheel I^x thus turns one-quarter of a revolution and the word "Repos" (rest) appears opposite the opening provided above the wheel I^x. It is thus evident that after the pressure has been exerted by the two subscribers x z upon the knobs V^4, the whole is brought back to the zero position and the mechanisms are ready for a new conversation. The same phenomena would take place in the same succession if instead of entering into communication with the subscriber z the subscriber x had entered into communication with another subscriber, and if instead of the carriage E^x having become hooked onto the beam R it had been hooked onto the beam R'.

In order to prevent any subscriber from unduly monopolizing a beam, I provide a counting apparatus of any suitable kind at the extremity of each of these organs. This counting apparatus is actuated by the lowering of the beam, and at the expiration of a given lapse of time automatically completes the circuit of the electromagnets W W' for the return.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a switchboard system for automatic intercommunication, the combination with a number of subscribers' lines, of carriages one for connection with each of said lines, switchboards or contact-plates at the central station of less number than the number of subscribers, each switchboard having contacts for all of the subscribers' lines, devices—such as beams—in electrical connection with the switchboards and with which the carriages are adapted to make contact to complete the circuit to the switchboard, substantially as described.

2. In a switchboard system for automatic intercommunication, the combination with a number of subscribers' lines, of carriages to which the terminals of said lines are respectively connected, switchboards or contact-plates at the central station of less number than the number of subscribers, beams corresponding to and electrically connected with the switchboards respectively, said beams lying normally in the path of the carriages and adapted upon contact of one carriage therewith to be moved out of the path of the others, and means controlled from each subscriber's station for actuating his corresponding carriage, substantially as described.

3. In a switchboard system for automatic intercommunication, the combination with a number of subscribers' lines, of carriages to which the terminals of said lines are respectively connected, switchboards or contact-plates at the central station of less number than the number of subscribers, beams corresponding to and electrically connected with the switchboards respectively, said beams lying normally in the path of the carriages and each adapted upon contact of one carriage therewith to be moved out of the path of the others, means controlled from each subscriber's station for actuating his corresponding carriage, and means for automatically returning the carriages to their starting-point when all of the beams have been moved out of the path thereof, substantially as described.

4. In a switchboard system for automatic intercommunication, the combination with a number of subscribers' lines, of carriages to which the terminals of said lines are respectively connected, switchboards or contact-plates at the central station, one corresponding to a number of the subscribers, beams corresponding in number to and electrically connected with the switchboards respectively, said beams lying normally in the path of the carriages and being adapted upon contact with one carriage to be moved out of the path of the others, a motor for driving each carriage connected in a local circuit, a switching device or commutator for closing said circuit, an electromagnet in another circuit for actuating said switching device, an electromagnet on the carriage adapted when energized to close said latter circuit, and means at the subscriber's station for closing a circuit through the electromagnet on the carriage, substantially as and for the purpose set forth.

5. In a switchboard system for automatic intercommunication, the combination with a number of subscribers' lines, of carriages to which the terminals of said lines are respectively connected, switchboards or contact-plates at the central station, one corresponding to a number of subscribers, beams corresponding in number to and electrically connected with the switchboards respectively, said beams lying normally in the path of the carriages and being adapted upon contact with one carriage to be moved out of the path of the others, a motor for driving each car-

riage connected in a local circuit, a switching device or commutator for closing said circuit, an electromagnet in another circuit for actuating said switching device, an electromagnet on the carriage adapted when energized to close said latter circuit, means at the subscriber's station for closing a circuit through the electromagnet on the carriage, and contacts, connected with the circuit for actuating the switching device, in proximity with the beams and with which the carriages are adapted to make contact, when engaged by the beam, to close the circuit to actuate the switching device and open the motor-circuit to stop the carriage, substantially as described.

6. In a system of the kind described, the combination with a subscriber's line-wire, a carriage therefor, and beams connected respectively with the switchboards and with which the carriage is adapted to engage, of a motor for moving said carriage in opposite directions according to the direction of the current energizing the same, a battery for supplying the current, a switching device interposed between said battery and motor for connecting the circuit through the latter in opposite directions, and for breaking the same, said device consisting of a contact-arm connected with the motor, and a series of alternately-arranged conducting and non-conducting plates with which the arm is adapted to make contact, the conducting-plates being alternately connected respectively with the positive and negative poles of the battery, and electromagnetic devices controlled from suitable mechanisms on the carriage for moving the arm over the contact-plates, substantially as described.

7. In a system of the kind described, the combination with a subscriber's apparatus and carriage corresponding thereto, of a switch comprising a bar carrying two contact-blades at each end, the blades at one side being respectively connected with electromagnets for operating the switch, and one of said blades being also connected with the diagonally-opposite blade at the other side of the bar, and the remaining blade on said latter side being suitably connected with the carriage, and two fixed contacts with which the blades are to respectively engage in proximity to each end of the bar, those contacts at one end being connected with the subscriber's line and those at the other end to the subscribers' contacts on the switchboard at the central station, substantially as and for the purpose set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

MOÏSE FREUDENBERG.

Witnesses:
CLYDE SHROPSHIRE,
EDWARD BARBURY.