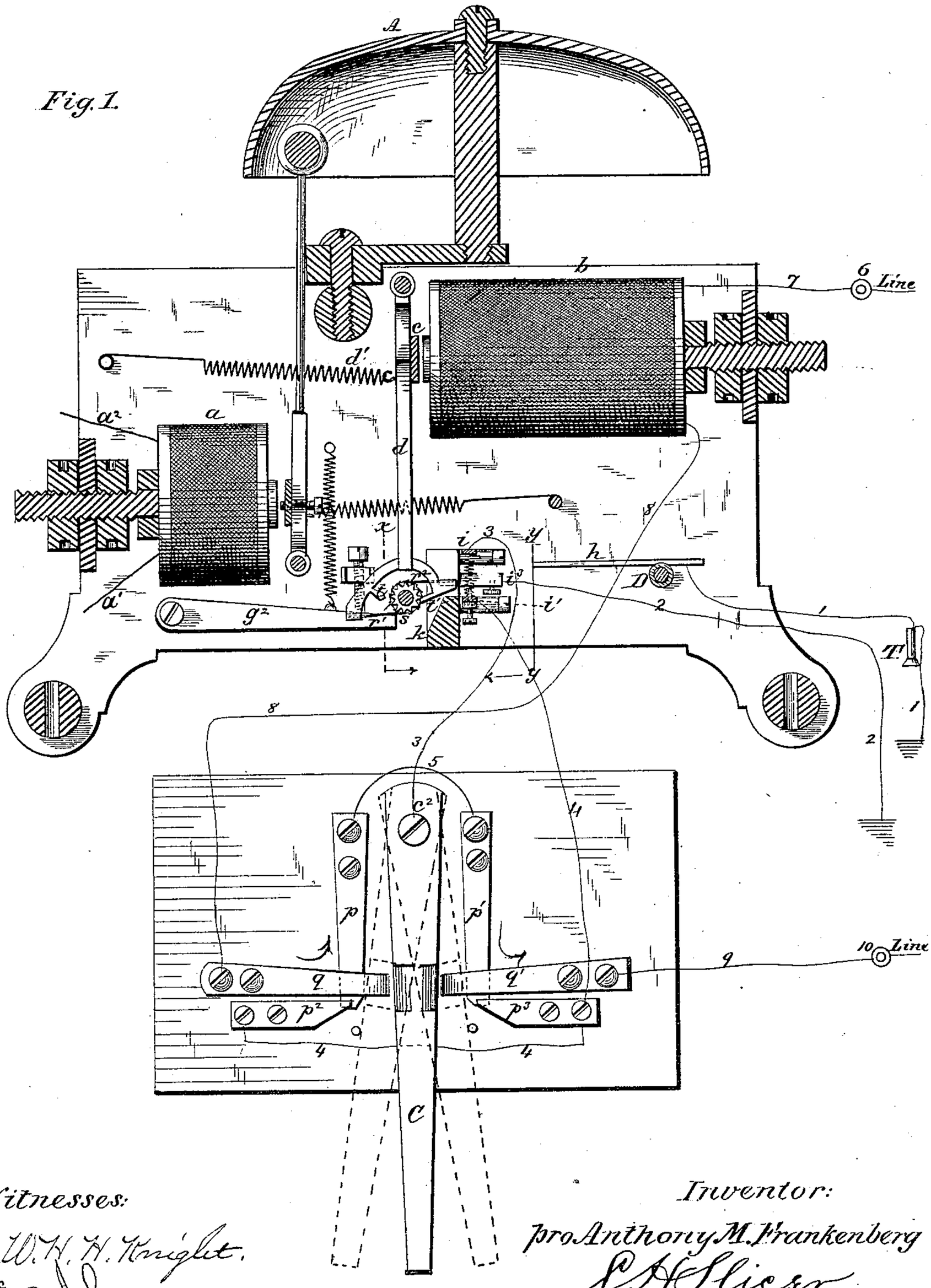
(Model.) 4 Sheets—Sheet 1.

A. M. FRANKENBERG.

SWITCH FOR DISTRICT TELEPHONE LINES.

No. 246,305. Patented Aug. 30, 1881.

Fig. 1.



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(Model.) 4 Sheets—Sheet 2.

A. M. FRANKENBERG.

SWITCH FOR DISTRICT TELEPHONE LINES.

No. 246,305. Patented Aug. 30, 1881.

Fig. 2.

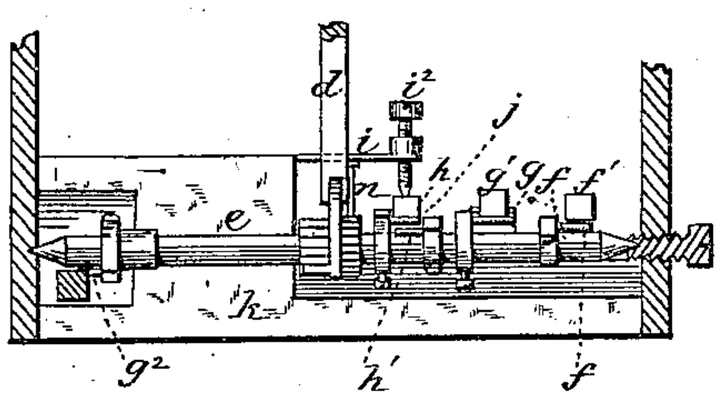


Fig. 6.

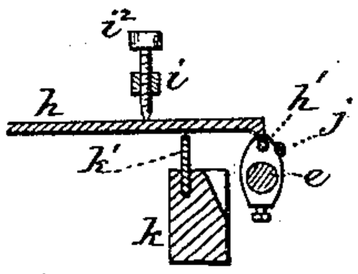


Fig. 3.

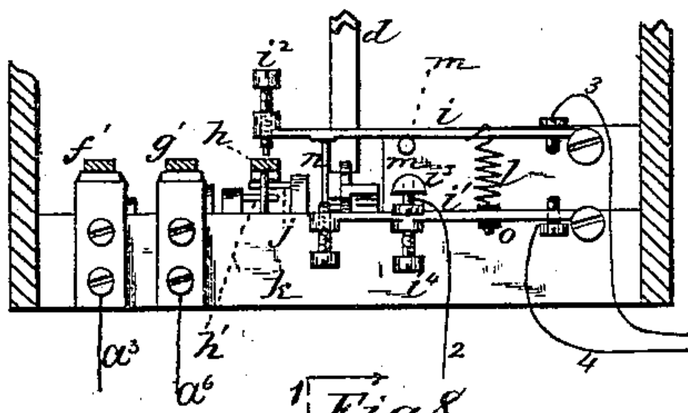


Fig. 4.

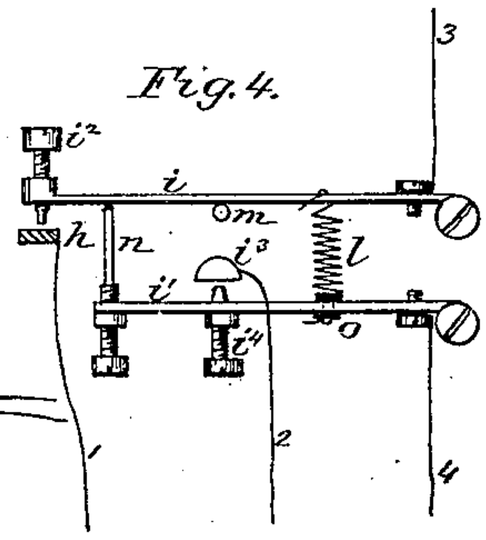


Fig. 8.

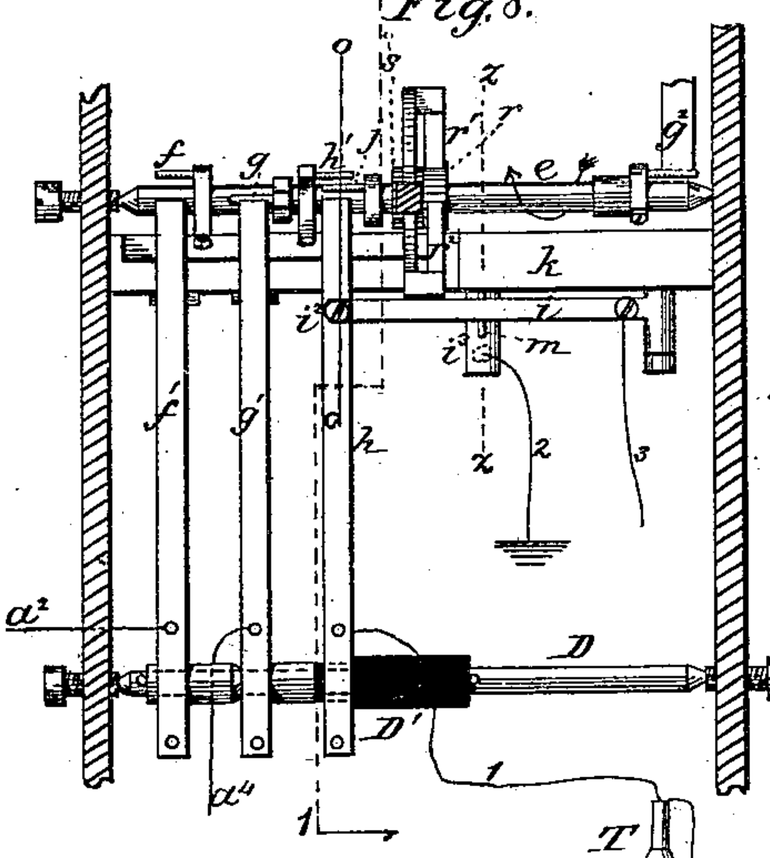


Fig. 7.

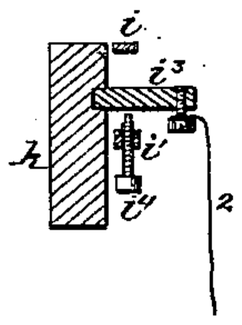


Fig. 5.

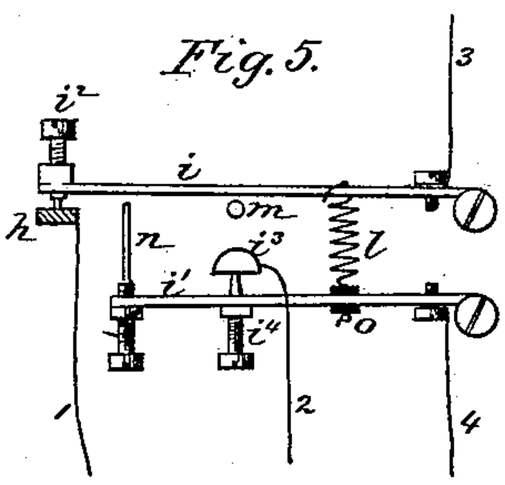
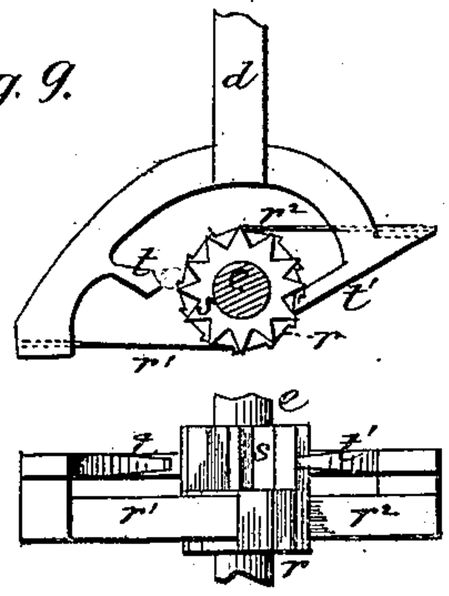


Fig. 9.



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(Model.) 4 Sheets—Sheet 3.

A. M. FRANKENBERG.

SWITCH FOR DISTRICT TELEPHONE LINES.

No. 246,305. Patented Aug. 30, 1881.

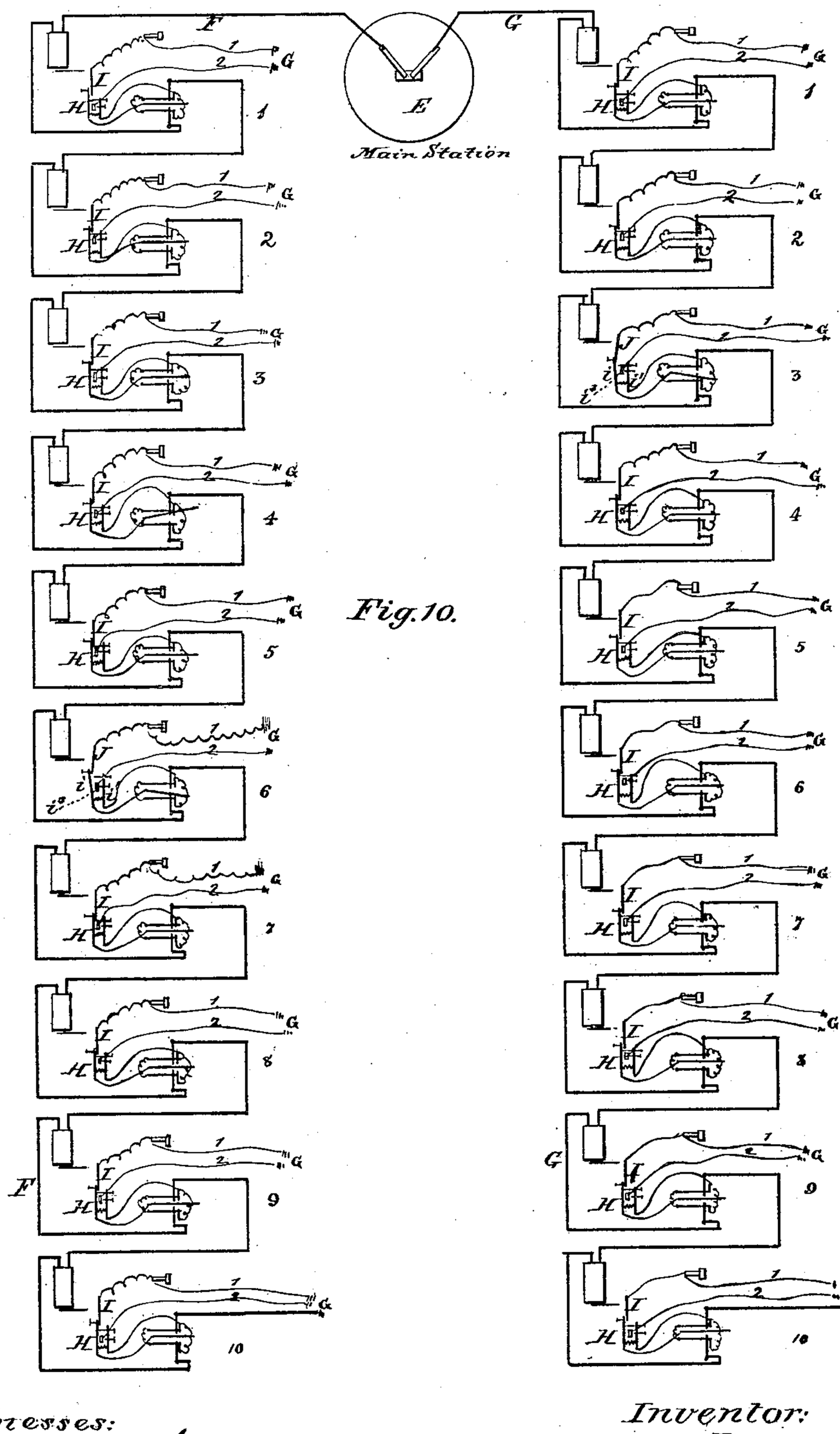

Fig. 10.

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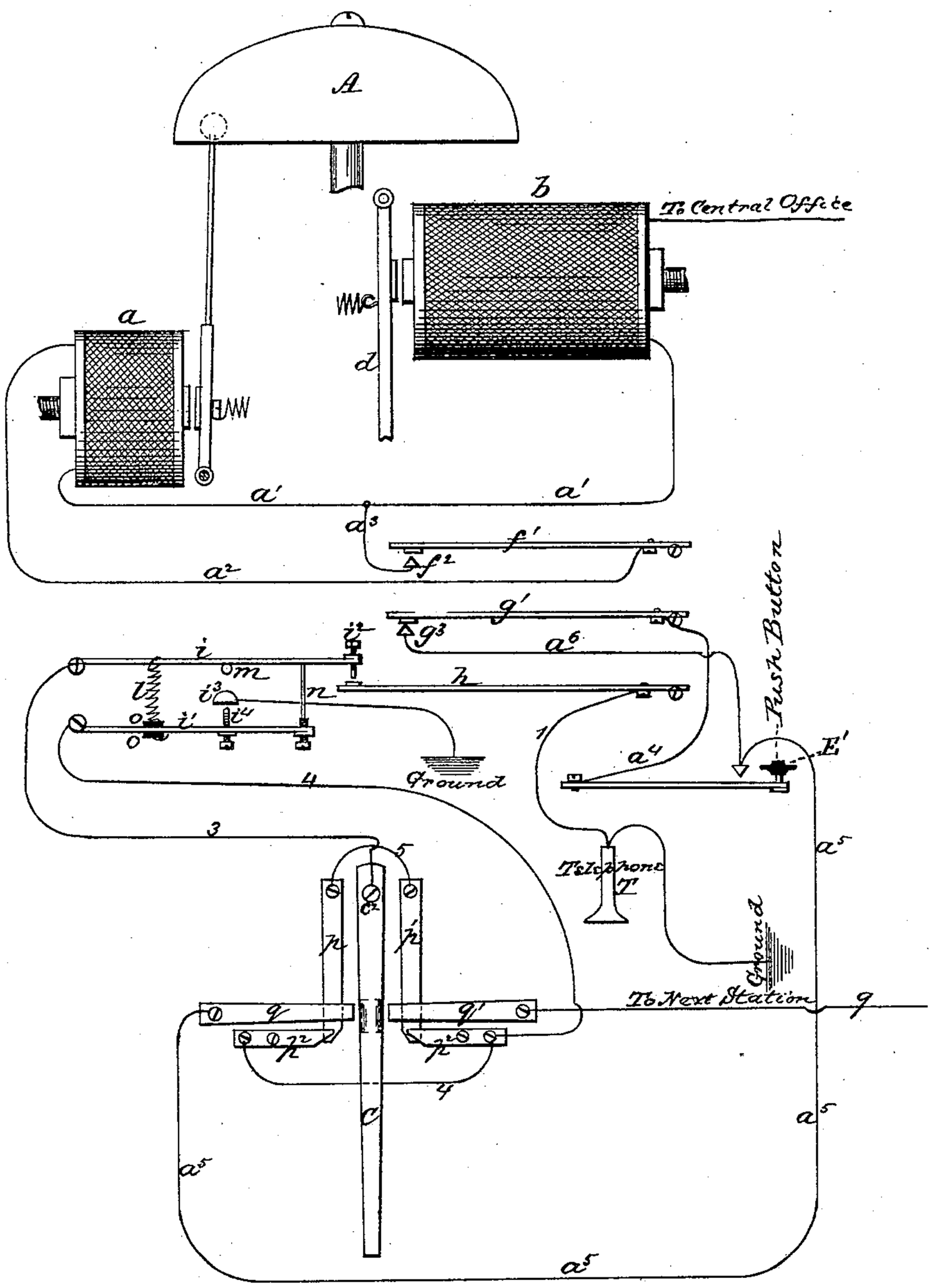
(Model.) 4 Sheets—Sheet 4.

A. M. FRANKENBERG.

SWITCH FOR DISTRICT TELEPHONE LINES.

No. 246,305. Patented Aug. 30, 1881.

Fig. 11.



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Howell Bartle.

Inventor:
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UNITED STATES PATENT OFFICE.

ANTHONY M. FRANKENBERG, OF BALTIMORE, MARYLAND.

SWITCH FOR DISTRICT-TELEPHONE LINES.

SPECIFICATION forming part of Letters Patent No. 246,305, dated August 30, 1881.

Application filed November 6, 1880. (Model.)

To all whom it may concern:

Be it known that I, ANTHONY M. FRANKENBERG, of Baltimore city, in the State of Maryland, have invented certain new and useful Improvements in Switches for District and other Telephone Lines; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

In an application for a patent filed by me October 24, 1879, I have shown and described certain improvements in electric signal apparatus for telephones, in which all the circuit-instruments having single ground-connections are entirely controlled and operated by means of a battery and a transmitter at the central or main station and under the control of the operator in charge. Among other objects and results effected by such central-controlling system are the making and unmaking of a single ground-connection of the circuit-stations from the main office, and preventing the improper use of the ground-connections at the stations by the subscribers. While in such invention I effect the control of the single ground-connections from the main office, I do not, however, make the communications private, and to this end my present improvements are directed.

My means of my present invention the operator at the main station and any one of the subscribers upon any one line, when connected through with another line, can hold private telephonic communications with any subscriber upon such through line to the exclusion of all interference from the subscribers on either line. In effecting this object I employ a double ground-connection in combination with an organization of devices for each circuit-instrument for controlling the ground-connections of each or all the circuit-instruments at will from the main station.

Referring to the accompanying drawings, Figure 1 represents a vertical longitudinal section of a circuit-instrument, showing its auxiliary switch and double ground-connections, the line of section being taken through the line 1 1 of Fig. 8; Fig. 2, a transverse section of so much of the circuit-instrument as shows the tappet-shaft and escapement, taken on the line *x x* of Fig. 1; Fig. 3, a similar section, showing the ground-controlling devices and their operating connections, taken on the line *y y* of Fig. 1. Fig. 4 shows the spring-coupled levers which constitute the means for connecting the line-wire with the two ground-wires, detached and on an enlarged scale, the double ground-connections being shown as broken; Fig. 5, a similar view, the double ground-connections being shown as made; Fig. 6, a detached sectional view of a portion of the ground-making lever on the line *o o* of Fig. 8, showing its relation to the upper one of the line-connecting levers, and Fig. 7 a detached sectional view on the line *z z* of Fig. 8, showing the connection of the lower line-connecting lever with the ground-making contact-point, the connected levers thereby making separate ground-connections; Fig. 8, a partial horizontal section, showing the relation of the tappet-shaft to the ground-making lever, the upper line-connecting lever, and the escapement; Fig. 9, enlarged sectional and bottom views of the escapement; and Fig. 10 is a diagram illustrating the connections of the circuit-instruments, and showing a station, 6, on one line in private communication with a station, 3, on another line, to the exclusion of all others, the two lines being connected through at the main station. In this diagram is also shown a station, 4, between the two stations in private communication, switched in but cannot hear the private communication. Fig. 11 shows the bell and push-button circuits and their relation with the switch, the coupled levers, and ground-circuits.

In these several views the same letters indicate the same parts.

It is understood that the main station (indicated by E) is provided with a suitable transmitter, batteries, and office appliances for connecting and operating the different circuit-instruments, preferably such as shown and described in my said application, and in which a sectional battery is used, its sections having different degrees of power for the purposes therein stated.

The circuit-instrument is provided with a

bell-operating electro-magnet, *a*, and an electro-magnet, *b*, for operating the armature *c*, which, by its pivoted lever *d*, operates the escapement device carried by said lever and revolves the tappet-shaft *e*, which operates the ground-making and line-connecting levers. The electro-magnets have proper line-connections for operating the mechanisms of the circuit-instruments.

The specific matter of my present invention is intimately connected with the devices constituting the tappet-shaft and its driving mechanism, and beyond this I do not, therefore, deem it necessary to particularly describe the circuit-instrument in all its details.

The tappet-shaft *e* is arranged in suitable bearings in the side plates of the frame, and between and below the magnets, as shown in the drawings. The tappet *f*, Figs. 2 and 8, is for operating the circuit-breaking lever *f'* for shunting out the call-bell A, and the tappet *g* is for operating the circuit-breaking lever *g'* to shunt out the push-button of the instrument, while the tappet g^2 operates a unison mechanism for bringing the tappet-shafts of all the circuit-instruments to the normal point. These operations are effected and controlled by the transmitter and battery at the main station, and they form no part of my present invention. The bell and push-button circuits, however, are shown in Fig. 11 in their relation with my present invention, and these circuits I will now briefly trace and describe in connection with such figure.

The bell A is shown in circuit by the wires a' a^2, and it is shunted out by means of the wire a^3, the contact-point f^2, and the circuit-breaker *f'*, when the latter is resting upon said contact-point. The push-button E' is in circuit by means of the wires a^4 a^5, and is shunted out by means of the wire a^6, the contact-point g^2, and circuit-breaker *g'*, when the latter is resting upon the contact-point g^3, and the relative connections of these circuits, with my improved call apparatus, can be readily traced through the switch, the coupled levers *i i'*, and the ground-circuits, which are also shown in the view referred to.

The levers *f'*, *g'*, and *h* are hinged upon a cross-shaft, D, Figs. 1 and 8, the ground-making lever *h* having a non-conducting bushing or bearing, D', on said shaft, by which the ground-wire 1 is kept insulated from the circuit-breakers and apparatus, otherwise there would be a permanent ground-connection. The lever *h* is connected to the telephone and then to the ground by the wire 1, Figs. 1 and 8, and it is operated by the tappet *h'*; and, by means of the spring-coupled levers or movable members *i i'*, operated by the same means, both ends of the line are grounded at the circuit-station without breaking the continuity of either section of the line, thereby establishing private communication to the main station, or through the main station to a circuit-station on another line, and this is a primary feature of my invention. I employ an additional tappet, *j*, to operate these same levers *h i i'* simultaneously in each of the circuit-instruments for the purpose of making ground-connections for each of the instruments, whereby any two subscribers on the same line can communicate with each other; and while this has been hitherto effected, yet the means by which I effect this are new.

The tappet *h'* is adjusted upon its shaft *e* differently at each station, so as to make the ground-connections successively at each station, and this is the means for putting any particular station in private communication with the main station or with a station upon another line. This successive connection is made by raising the lever *h* successively at each station. For instance, the tappet *h'* at station No. 1 is adjusted on the shaft *e* so as to raise said lever *h* after the shaft has been moved forward one tooth of the escapement-wheel, while at station No. 2 the tappet *h'* is adjusted on the shaft *e* so as to raise said lever after the shaft has been moved forward two teeth, and so on throughout all the circuit-instruments.

The tappets *j* are arranged in all the instruments so as to succeed in their action that of the tappets *h'*; but, as before stated, their action in all the instruments is simultaneous to effect the object before stated.

The spring-coupled levers *i i'* make the two ground-connections, the first being made by the top lever, *i*, and its metallic contact-point i^2 with the lever *h*, while the second of these ground-connections is made by the lower lever, *i'*, and a metallic insulated projection, i^3, and contact-point i^4, and from which metallic projection the second ground-connection is made by the wire 2. These levers *i i'* are hinged to a hard-rubber sill, *k*, and they are coupled by a spring, *l*, Figs. 3, 4, and 5, by which the raising of the top lever by the action of the tappet *h'* upon the lever *h* is caused to raise the lower lever, *i'*, to make the second ground-connection through the contact-point i^4, carried by said lower lever. The lever *h* breaks its ground-contact with the top lever, *i*, by dropping of its own weight upon an insulated pin, *k'*, Fig. 6, and thus separating from the contact-point i^2, while the descent of the top lever, *i*, is arrested by a pin, *m*, Figs. 3, 4, and 5, on the non-conducting sill. In the descent of the top lever, *i*, it makes a contact with a screw, *n*, Figs. 3, 4, and 5, carried at the free end of the lower lever, for the purpose of bringing the levers into contact with each other to connect both ends of the line, the spring *l* being insulated from one of the levers, as shown at *o* in Figs. 3, 4, and 5.

The object of coupling the levers *i i'* by means of a spring is to allow the upper lever to have a slightly greater movement than the lower lever, and cause the movements of the upper lever, *i*, to control the movements of the lower lever, *i'*, in making and breaking the ground-connections. The making and break-

ing of these connections are, however, not simultaneous, but follow in quick succession. In their normal position, or position of rest upon the pin *m*, these levers have their ground-connections broken, as shown in Fig. 4, and the line is closed through the screw-contact point *n*. The raising of the upper lever, *i*, by the lever *h* makes the first ground-connection, and in quick succession the second ground-connection is made by the screw i^4, carried by the lower lever touching the projection i^3, and immediately following this last contact the contact between these levers is broken by the lifting of the upper lever from the screw-contact *n*, as shown in Fig. 5. In the downward movements of these levers they come in contact with each other first by the screw *n*, and in quick succession the lower lever releases its contact with the projection i^3, and then follows the breaking of the lever *h* with the lever *i*.

The reason for making the contact between the coupled levers in their downward movement, and before they are released from their ground-contact points, is to connect the two ends of the line before the ground-circuits are broken; otherwise the continuity of the line could not be preserved.

In the drawings I have shown the making of the contact between the coupled levers by a screw, *n*, carried by the lower lever; but it is obvious that such point may be carried by the upper lever with the same result. So, in like manner, the screw i^2 may be carried by the lever *h* and the contact-screw i^4 set in the projection i^3. The device of the coupled levers is perfect for the purpose designed; but I do not wish to be confined to the specific construction and arrangement shown, as these may be changed and effect the desired results in controlling the two ground-connections.

The line-connections with the two ground-connections 1 and 2 are made by the wires 3 and 4, which are connected with the spring-coupled levers *i i'*, as shown in Figs. 1, 3, 4, and 5, and which levers connect with an auxiliary switch of novel construction, and which I will now describe. This switch-insulated bed, Fig. 1, is secured to any part of the circuit apparatus. It consists of a lever, C, pivoted at one end by a screw, c^2, and is arranged to be moved to the right or to the left, and is in metallic connection with the top one, *i*, of the coupled levers by the wire 3. Arranged in line with each other, parallel to and at each side of said lever C, is secured a metallic spring-plate, *p p'*, which are in metallic connection with each other through the wire 5. Crossing the free ends of these springs are two other metallic spring-plates, *q q'*, having their free ends overlapping those of the under springs and constantly pressing thereon, holding them away from their contact-points p^2 p^3 when the switch-lever C is in its normal position or out of action. The distance between the ends of the spring-plates *q q'* must be greater than the width of the lever C, which is provided with a bearing by which to pass under and raise said spring-plates *q q'* when the switch-lever is turned to the right or to the left to switch in the telephone.

The switch operates as follows, viz: In its normal position the circuit through the apparatus is from the line binding-post 6 through the wire 7 to the electro-magnet *b*, thence through the wire 8 to the spring-plates *q* and *p*, the wire 5 to the spring-plates *p'* and *q'*, through the wire 9 to the binding-post 10. To permit the telephone to be connected with the main station, or with any station between the main station and the communicator, the switch-lever is turned to the left, and the circuit is from the binding-post 6 to the spring-plate *q*, the lever C, and thence by the wire 3 to the upper lever, *i*, through the contact-point *n* of the lower lever, *i'*, through the wire 4 to the contact-points p^3 and p^2, thence through the spring-plate *p*, the wire 5, to the spring-plates *p'* and *q'*, to the binding-post 10. In this connection the switch-lever lifts the spring-plate *q* from its pressure upon the spring-plate *p*, and allows the latter to rise against the contact-point p^2, thus making the connection to said post 10 and the line. To communicate in the opposite direction from that just described, on the same line, the switch-lever is turned to the right, making the circuit from the binding-post 6, the joining plate-springs *q* and *p*, to the contact-point p^3, and thence through the wire 4 to the levers *i'* and *i* by the contact-point *n*, and from said lever *i* by the wire 3 to the switch-lever C, and through the spring-plate *q'* to the binding-post 10 and the line. When the subscriber desires to have telephonic communication with the central station or any circuit-station he turns the switch-lever C to the right or to the left to connect both sections of the line with the spring-coupled levers *i i'* of his instrument, and thereby completes the line through said levers. The central station having been previously called by the call-bell, the main-station operator then makes the ground-connection at such station by the lifting of the lever *h*, (by operating the mechanism in the circuit-instrument by means of the battery and the apparatus at the main station,) thereby putting the spring-coupled levers *i i'* in connection with the ground-wires, and thus grounds both sections of the line, within one of which ground-wires the telephone is included, and this is the means by which a subscriber is put in telephonic communication with the main station or a circuit-station, and hence it will be noticed that the subscriber can only obtain telephonic communication at the will of the operator at the main station.

The peculiarities of the switch consist in the arrangement of the spring-plates and contact-points in relation to the lever, whereby I not only control the ground-wires at the circuit-stations from the main stations, but make both ground-connections without breaking the con-

tinuity of either section of the line, and by which the switch is adapted for the specific use of mechanism for effecting private communications.

The escapement consists of two toothed wheels, *r s*, Fig. 9, on the tappet-shaft *e*, and having an equal number of teeth, into one, *r*, of which engage two spring-pawls, r' r^2, carried by the oscillating lever *d*, and operating to rotate the tappet-shaft one-half of a tooth, either by the forward or backward movement of said lever, the forward movement being effected by the attraction of the armature *c*, and the backward movement by the retracting-spring d', when the magnet is discharged. The lever *d* has two detents, *t* t', which engage with the teeth of the wheel *s* after each movement of the tappet-shaft and prevent it from moving either forward or backward, and make a reliable escapement.

In the diagram is represented two lines, each having a number of circuit-stations located thereon, connected through the main station E, and each capable of effecting the double ground-connection. In this diagram the stations on each line are numbered from 1 to 10, and the lines are designated by the letters F and G, to illustrate how private communications are had on one line to the main station, or to a station on another line through the main station. At all the stations but that numbered 6 on line F and that numbered 3 on line G the spring-coupled levers *i* i' (indicated by H) are shown as having no ground-connections, the letter I representing the ground-making lever *h*, which is shown as being open, while in station No. 6 on line F, and in station No. 3 on line G these levers *h* (indicated by J) are shown as being in contact with the upper lever, *i*, and the lower lever, i', as being in contact with the metallic projection i^3, and in this way the double ground-connections 1 and 2 are made, and thus these two stations 6 and 3 are put in private communication, and to the exclusion of all interference from the subscribers on either line. At these stations the switch-levers are shown as having switched in the telephones. It will be understood that this double ground-connection can only be made from the main station by means of the transmitter and battery operated there and at the request of the communicator, or at the will of the operator at the main station.

To illustrate how the privacy of communications between the two stations designated above may be maintained without interruption, I have shown in station No. 4 on line F the switch-lever as being moved in the position to make telephone-communication by a subscriber intending to overhear the communications which are passing between stations No. 6 and No. 3 on the two lines; but as his telephone can have no connection with the line, for the reason that the connection between the ground-lever *h* and the upper lever, *i*, is broken, as in all the other stations, except those numbered 6 and 3, it follows that neither No. 4 nor any other station can interfere, and the movement of the lever at No. 4 or any other station will be without effect.

The operation of the circuit-instruments is as follows, viz: The operator at the main station desiring to converse with the subscriber at station No. 6, line F, he closes and opens the circuit six times. When the circuit is closed for the sixth time the tappet h' will be immediately under the lever *h*, and when it is opened for the sixth time the armature *c* is released from the magnet *b*, the lever *d* is drawn back by the retracting-spring d', the spring-pawl r^2 engages with the wheel *r* and moves the shaft *c* forward one point, which brings the tappet h' in contact with the lever *h*, which is thereby thrown up, and makes contact with the lever *i* at i^2 and raises it, thereby connecting the telephone with the switch-lever C. The lever i', being held up by the spring *l*, is also raised during the lifting of the lever *i*, and is brought in contact with the insulated metallic projection i^3, to which is attached the ground-wire 2. The subscriber now turns the lever C to the left, which brings it under the spring-plate *q*, raises it, and allows the spring-plate *p* to come in contact with the contact-point p^2. During this operation of the lever C by the subscriber both ends of the line are put to earth at his station without breaking the continuity of either section of the line, one end of the line being put to earth at *q* through lever C, wire 3, lever *i*, contact-point i^2, lever *h*, through telephone T, and ground-wire 1. The circuit of the other end of the line to the earth is from binding-post 10, wire 9, spring-plate q', spring-plate p', wire 5, spring-plate *p*, contact-point p^2, wire 4, lever i', insulated metallic projection i^3, and ground-wire 2. It will be seen that the telephone at station No. 6, line F, is the only one in contact with the line, all others being disconnected at the contact-point i^2. Station No. 6 can now communicate privately with the operator at the main office; or, if the line is connected through to another line similarly arranged, can communicate secretly with another subscriber upon such line, to the exclusion of all others. At the end of the conversation the operator at the main station restores all instruments to their normal position, which is done by moving the tappet-shaft in all the instruments until the normal or zero point is reached. At the first movement of the shaft during this operation the ground-connections at station No. 6 are broken and both ends of the line connected, thereby re-establishing a circuit throughout the entire line. This is accomplished in the following manner: Suppose subscriber No. 6 has his telephone switched to line, which really grounds the line at his station. The operator at the main station then puts his battery to line. The electro-magnet *b* is magnetized and attracts the armature *c* on the lever *d*, thereby moving said lever *d*,

causing the spring-pawl r' to engage with the wheel r, moving the shaft e forward one point. The tappet h' is thereby moved from under the lever h, which drops, allowing the spring-coupled levers $i\ i'$ to make contact with each other through the screw n, thereby connecting the two sections of the line and breaking the contact with the lever h at i^2. The lever i' is by this means caused to drop by its own weight, breaking its contact with the insulated metallic projection i^3. The levers $i\ i'$ are so adjusted as to make contact with each other before the ground-connections are broken, so that there will be no break in the circuit. There is another tappet, j, upon the shaft e, adjusted alike in each instrument, so that the lever h is raised simultaneously in each instrument. This arrangement becomes necessary when any two subscribers upon the same line wish to communicate with each other.

The operation of this mechanism is as follows: Suppose subscriber at station No. 2 desires to converse with subscriber at No. 5. He calls the main-station operator, who answers by giving a blow upon the bell at No. 2. The subscriber then switches his telephone to line by turning lever C of the switch to the left, and notifies the operator at the main station to connect him with subscriber No. 5, and then turns the lever C to the right, thereby connecting his telephone to "line out"—that is, that part of the line running to station No. 5. The telephone at station No. 4 cannot be embraced in the circuit with No. 5, because the ground-connections, which are under the control of the main station, have only been made for station No. 5, to the exclusion of all other stations on the line, including No. 4. The main station then calls subscriber No. 5 and tells him of the fact, and then moves the shaft e in all the instruments until the point is reached where the tappet j raises the lever h, and the two subscribers can now converse with each other. At the end of the communication station No. 2 turns the lever C to the left, which switches his telephone to "line in"—that is, that part of the line running to the main station—and tells the operator that he is done speaking to No. 5. The main-station operator then restores all the apparatus to the normal point by moving the shaft e forward one point.

It will be seen that the main station always has a circuit through any apparatus on the line, no matter which way the ground-lever C is turned, and therefore has complete control over all the mechanism in each instrument, and can operate them at will and place all subscribers beyond the power of interfering with the line, either by accident or design.

The number of stations on the line is limited to two less than the number of teeth in the wheel r. For instance, the wheel in this instrument has twelve teeth. The number of stations is therefore limited to ten, the first ten teeth being to give each of the ten stations separate ground-connections, the eleventh tooth is to give all of the ten stations simultaneous ground-connections, and the twelfth tooth is the normal point.

Any number of subscribers may be placed on one line by increasing the number of teeth in the escapement-wheels.

I claim—

1. In switches for telephone-lines, the combination of a ground controlling device for the circuit-instrument, consisting of two coupled levers, $i\ i'$, or movable coupled members, through which the line is made and broken through a contact-making screw, n, carried by one of said coupled members, with a ground-making lever, h, operating with one of said coupled members, and an insulated ground-contact-making projection, i^3, operating with the other of said coupled members, the said movable members being connected with the line, whereby, in the upward movement of these coupled members both ends of the line are put to ground at the circuit-station directly and exclusively from the main station, and without breaking the continuity of either section of the line, the downward movement of said coupled members operating to join the sections of the line and to break the ground-connections thereof, for the purposes specified.

2. The combination, in a switch for telephone-lines, of a ground controlling device consisting of coupled levers or movable coupled members, through which the line is made and broken, substantially as specified, with a ground-contact-making lever, h, and operating-tappet h' therefor, a fixed ground-making insulated projection, i^3, operating with one of said coupled levers and the driving mechanism for said tappet, whereby private telephonic communications are established with the main station, or with another station on another line through the main station, the said tappet being adjusted to operate upon the ground-making contact-lever at a different time at each station, substantially as herein set forth.

3. The combination, in a switch for telephone-lines, of a ground controlling device consisting of the coupled levers or movable coupled members $i\ i'$, through which the line is made and broken, substantially as specified, with a ground-contact-making lever, h, an operating-tappet, j, therefor, a fixed ground-making insulated projection, i^3, operating with one of said coupled levers, and the driving mechanism for said tappet, whereby the ground-making lever h of each station is raised simultaneously to allow telephonic communications to be made between any two stations on the same line, substantially as specified.

4. The ground-making lever h, operated by the tappets h' and j, the action of one succeeding that of the other, in combination with the ground-controlling coupled levers $i\ i'$, substantially as and for the purposes herein specified.

5. The combination, in a telephone-call apparatus, of the ground-making lever h, and the circuit-breakers f' and g', with the hard-rub-

ber bushing D′ upon the shaft D, upon which bushing said lever *h* is mounted, whereby the line-wires connecting with said circuit-breakers are prevented from being permanently grounded, substantially as specified.

6. The ground controlling-levers *i i′*, united by a yielding connection, *l*, one end of which is insulated, for the purpose specified.

7. The ground controlling-levers *i i′*, united by a yielding connection, one, *i′*, of which levers is provided with the contact-screw *n* for joining both sections of the line, and a contact-screw, i^4, for connecting said lever *i′* with the ground, and the other, *i*, of said levers having the contact-screw i^2 for connecting it with the ground-making lever, thereby effecting a double ground-connection, for the purpose set forth.

8. The ground controlling spring-coupled levers *i i′*, limited in their descent by the stop *m*, for maintaining them in position for the proper operation of the ground-making lever *h*, as specified.

9. The combination, in a telephone-call apparatus, of the tappet *h′*, the ground-making lever *h*, operated thereby, the spring-coupled levers *i i′*, and the contact-point i^3 with their line and ground connections 1, 2, 3, and 4, the said tappet *h′* being adjusted upon its shaft *e* differently at each circuit-station, and making the ground-connections successively at each circuit-station, whereby to put any particular circuit-station in private telephonic communication with the main station or with a circuit-station upon another line, substantially as set forth.

10. The combination, in a telephone-call apparatus, of the spring-coupled levers *i i′*, the insulated projection i^3, the stop *m*, and the contact-points *n*, i^2, and i^4 with the ground-making lever *h*, whereby the contact between the coupled levers in their downward movements is made before they are released from their ground contact-points, for the purpose of connecting the two ends of the line before the ground-circuits are broken, to preserve the continuity of the line.

11. The auxiliary switch consisting of the lever C, the spring-plates *p p′ q q′*, and the contact-points p^2 p^3, in combination with their connecting-wires 3, 4, and 5 and the line-connections 8 and 9, whereby double ground-connections are effected without breaking the continuity of the line, substantially as specified.

12. The combination of the auxiliary switch, constructed substantially as specified, with the ground controlling coupled levers *i i′*, the ground-making lever *h*, mechanisms for operating said levers, and their connecting-wires, substantially as and for the purpose specified.

In testimony that I claim the foregoing I have hereto affixed my signature in the presence of two witnesses.

ANTHONY M. FRANKENBERG.

Witnesses:
C. H. SLICER,
A. E. H. JOHNSON.