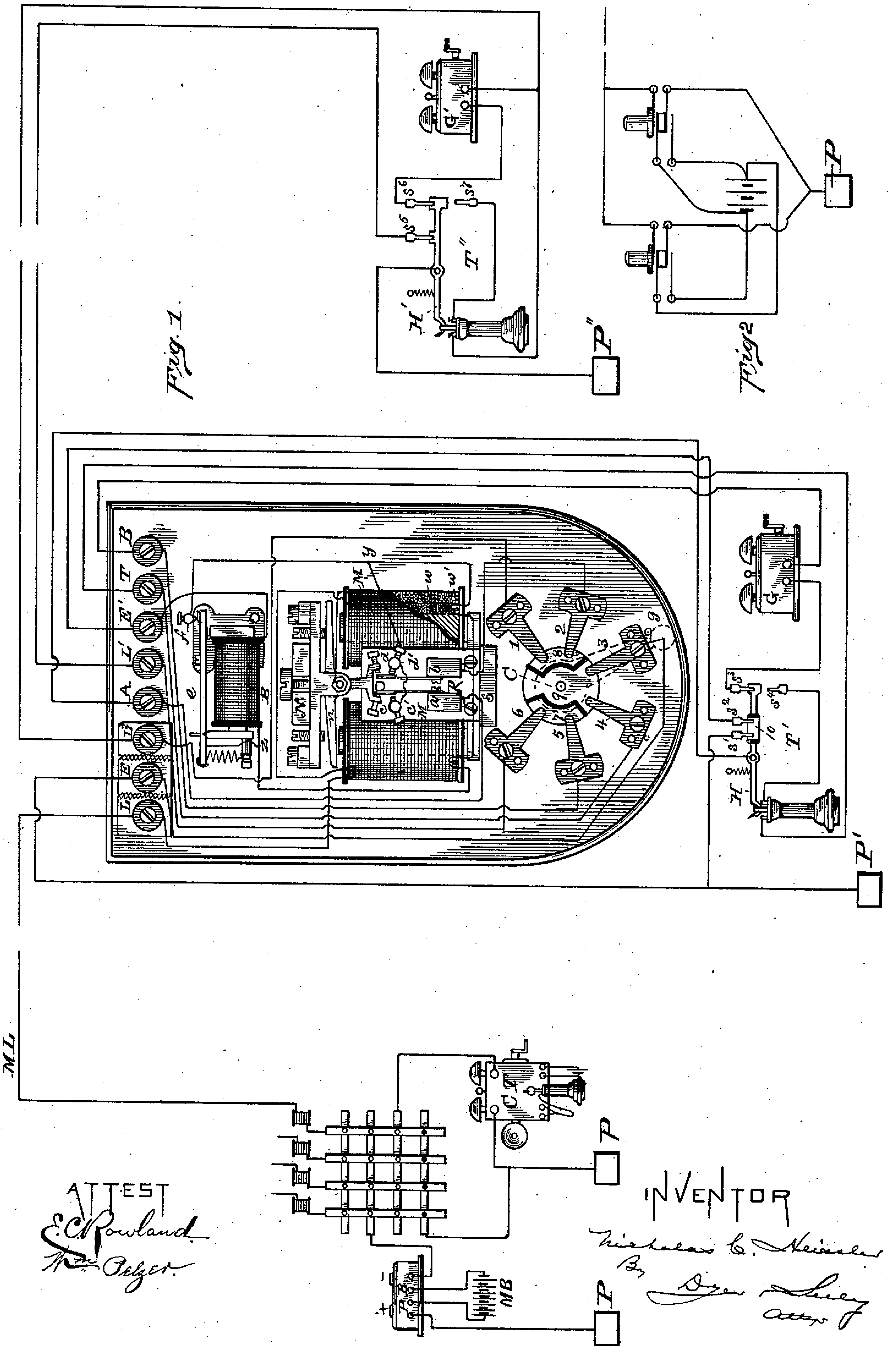
(No Model.)

2 Sheets—Sheet 1.

N. C. HEISSLER.

TELEPHONE SYSTEM.

No. 351,597. Patented Oct. 26, 1886.



N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

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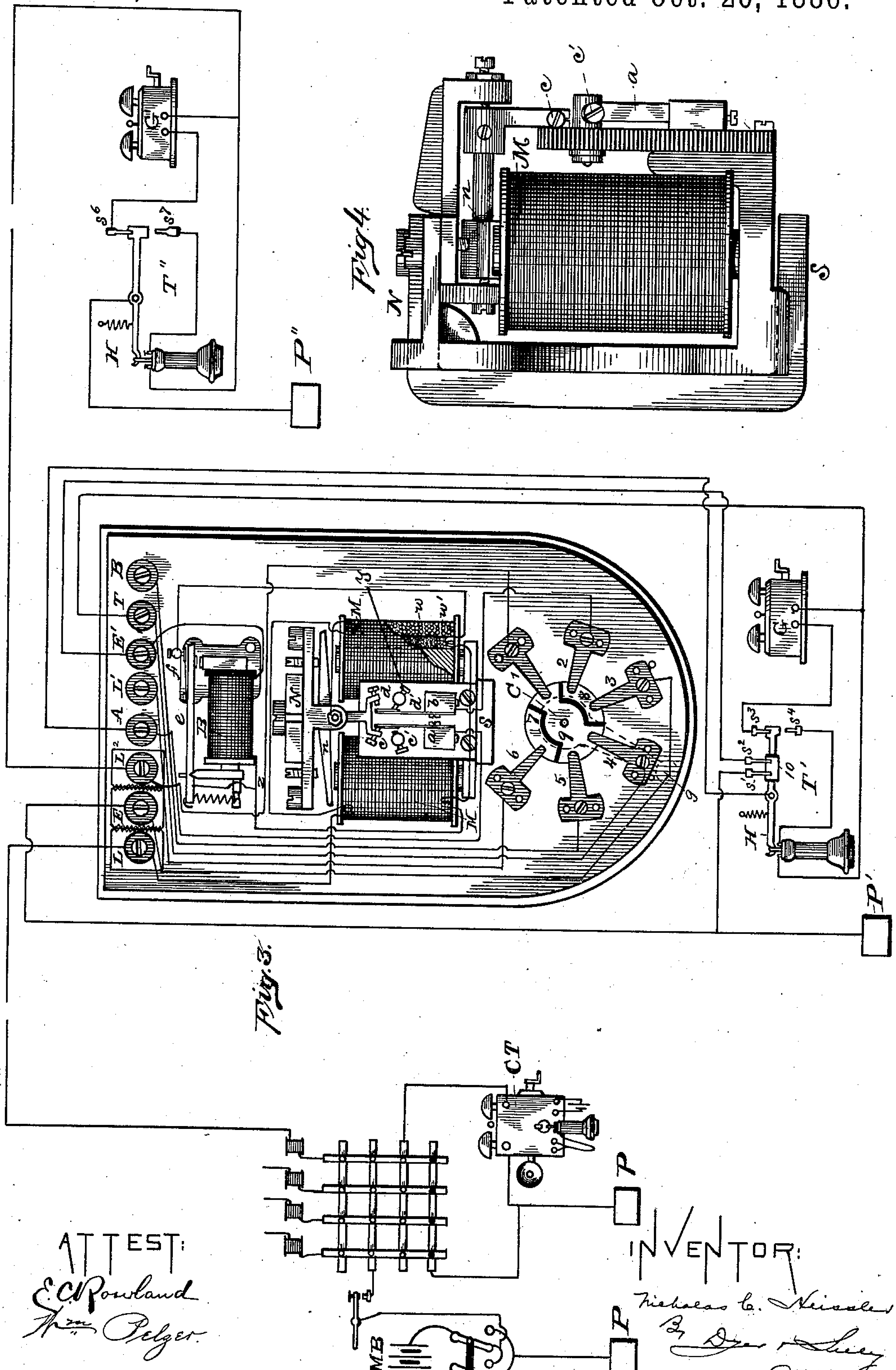

Fig. 4.

Fig. 3.

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NICHOLAS CONRAD HEISSLER, OF ST. PETERSBURG, RUSSIA.

TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 351,597, dated October 26, 1886.

Application filed July 23, 1886. Serial No. 208,834. (No model.)

To all whom it may concern:

Be it known that I, NICHOLAS CONRAD HEISSLER, a subject of the Czar of Russia, residing at St. Petersburg, in the Empire of Russia, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a specification.

The object I have in view is to produce telephonic apparatus which will enable one line to be used for the instruments of two subscribers, and will permit the independent use of the wire by each subscriber without disturbing the other, and without the liability of being interfered with or overheard by the other subscriber; and more especially my object is to do this by means which will enable the employment of the ordinary telephone-instruments and call apparatus in connection therewith, and will require no radical departure from the present methods of conducting telephone-exchanges, and which, further, will be simple in construction and not liable to get out of order or adjustment, and will be entirely certain in action and simple in its manipulation. The conditions of independent use of the line require that the central office should be able to call up either subscriber, or either subscriber call up the central office, without disturbing the other subscriber, and that when the instruments of one subscriber are in position for talking the other will not be able to interfere with the line in any way, and cannot overhear the conversation; also, that the two subscribers may be put into communication with each other.

The advantages arising from a practical apparatus accomplishing effectively the object stated are, that the cost of construction over the use of a separate line-wire for each subscriber is greatly reduced, while most of the benefits of the separate line for each telephone are retained.

In the accompanying drawings, forming a part hereof, Figure 1 is a view, partly in diagram, representing a central office and two telephones connected with the same line, the transmitters at outlying telephones being omitted for simplicity; Fig. 2, a view illustrating the central-office device for operating the polarized switch for making connections with either of the two outlying telephones; Fig. 3, a view like Fig. 1 of a modified arrangement of circuits, showing the position of hand-switch to connect the two outlying telephones together, and showing also a different form of the switching-key at central office; and Fig. 4, a side elevation of main magnet of the automatic switch.

The automatic switch, which is the most prominent feature of my apparatus, is constructed as follows: M M are the two bobbins of a differentially-wound electro-magnet, with inner circuit, *w*, composed of fine wire and outer circuit, *w'*, of coarse wire. The permanent magnet N S, extending behind the bobbins M M, as shown, polarizes the cores of the electro-magnet M M by contact and its armature *n* by induction, the magnet N S approaching very close to but not touching the armature. An extension of the armature *n* has two contact-screws, *c d*, both of them in electrical connection with the armature. Upon an insulated block, R, fastened between the bobbins M M, are two springs, *a* and *b*, insulated from each other, and limited in their motion by the two insulated screws *c'* and *d'*, which are in electrical connection with each other. By means of the screws *c c' d d'* the springs *a* and *b* are regulated, so that one of them will be in contact with the armature *n* by either *c* or *d*, while the other will be in contact with either of the screws *c'* or *d'*. For instance, in the drawings spring *a* is shown in contact with armature *n* by screw *c*, and is separated from screw *c'*, and spring *b* is shown in contact with screw *d'*, and is separated from the screw *d*, whereas if armature *n* were "tilted" the opposite would be the case. Spring *a* is connected to telephone T', and spring *b* is connected with telephone T''. The line from central office passes by binding-post L to and through outer circuit, *w'*, of electro-magnet M M, and terminates in contact with armature *n*.

As will be presently explained in detail, if spring *a* is in contact with armature *n* by screw *c*, then the telephone T' is in direct connection with central office, and telephone T'' is disconnected from armature *n* at screw *d*, and consequently disconnected from the central office, while if armature *n* were tilted the reverse would be the case. The armature *n* "tilts" or oscillates like all polarized relays and electro-magnets—*i. e.*, if a current of + polarity circulates through the coil the armature will be attracted to one pole of the electro-magnet, while a current of — polarity will cause it to be attracted to the other pole.

The auxiliary electro-magnet B is employed to short-circuit the inner or fine-wire circuit, *w*, of electro-magnet M M by means of armature *e* and contact-screw *f*, and to open this short circuit automatically when any current passes through the coil B, thus allowing the current to circulate through the fine coils *w* of electro-magnet M M to operate the armature *n*.

Manual reversing-switch C is only used when the two telephone-stations A and B desire to communicate with each other, in which case moving the handle to the left places them in connection with each other and with the central office, enabling the central office to control the communication and to receive the "disconnect" signal when conversation is finished.

The circuits are as follows: The main line M L, connected in central office through the ordinary signal-drop or other annunciator to earth, passes thence to telephone-station, going immediately to the automatic commutator at binding-post L, to and through outer or coarse-wire coils, *w'*, of polarized electro-magnet M M, terminating in electrical connection with armature *n*, to which are attached the two contact-screws *c* and *d*. From spring *a* a wire passes *via* binding-post A to telephone-hook H in telephone T', thence by spring s^3 through magneto call generator G to binding-post B, to contact-spring 5 7 6, to binding-post L', to telephone-hook H' in telephone T'', thence to earth at plate P''. From spring *b* line passes by contacts 2, 8, and 1 to binding-post L^2, to magneto-call generator G' at telephone T'', thence to earth by telephone-hook H' and plate P''. From earth at P' a line passes to binding-post E, thence by contacts 3, 9, and 4 to binding-post T, thence to and through telephone T' to spring s^4. A branch wire from P' passes by spring *s'*, insulated contact-piece 10 on switch-lever H, and spring s^2 to binding-post E', thence through coil of electro-magnet B, branching at *z*, where the two ends of inner fine-wire coil on electro-magnet M M, including contact-screw *f* and armature *e*, are connected. From a point, *y*, of this fine-wire circuit a connection is made with the two contact-screws *c'* and *d'*, as shown in Fig. 1.

Operation.

Case I: Central office wishes to call telephone T'. Plug in switch-board is removed from the earth-strip and placed in the hole intersecting the line M L and the cross-strip, to which the battery M B and push-buttons P B are connected. The operator then presses the button + several times, which connects zinc of battery M B to earth and copper to line M L, causing a + current to flow through line M L to binding-post L, through the outer or coarse-wire coil of electro-magnet M M to armature *n*. From this point the current goes to earth either *via* spring *a*, binding-post A to telephone T', fork H S^3, generator G, binding-post B, contacts 5 6 7, binding-post L' to telephone T'', spring s^5 to earth direct at P'', or *via* spring *b*, contacts 1 2 8, binding post L^2 to telephone T'', generator G', spring s^5 to earth at P''. The reason for one or the other of these routes being followed is, that the armature *n* remains in the position in which it was when last used. Therefore if telephone T' had the last connection the current would follow the first-mentioned route, while if telephone T'' had the last connection the route would be the last described. In the present case, with armature *n* as shown in the drawings, the current reaches earth by the first route. In circulating through the outer coil of electro-magnet M M the current causes the armature *n* to be tilted in the direction shown in the drawings. Naturally, if the armature is already in that position the currents do not affect it. The central office now removes the plug from the intersection of line and cross-strip with battery to the strip ordinarily used for signaling, and sends alternate currents, as usual, either from a magneto-generator or a "pole-changer," which pass through the coils M M, thence by spring *a*, with its connections, to and through bell of generator G, causing it to ring, thence on to telephone T'' at spring s^5, and to earth at P'' without passing through bell of generator G'. Armature *n* is mounted on pivots, and is very sensitive, and if no provision were made it would vibrate in response to the alternating currents passing through the coarse wire *w'* of coils M M, sending one half of the signal to T' and the other half to T'', and probably coming to rest in connection with telephone T'', if the last current should be of the polarity affecting the armature in that direction. This does not occur when direct currents are sent, but only when intermittent induced currents pass through the coarse-wire coils, for although the induction occurs, yet the direct currents are unavoidably prolonged sufficient to attract the armature *n*. To prevent these results the resistance of fine-wire coils *w* on M M is so proportioned to that of the coarse-wire coils *w'* that the currents of opposite polarity produced in the former by induction from the latter neutralize the effect of the currents in the coarse coils upon the armature *n*; hence no change in the position of the armature occurs, and the signals pass through and affect generator G only. This is a feature of prime importance, enabling alternating signaling-currents to pass directly through the polarized switch without vibrating its armature and without disturbing the connections produced by it. Telephone T' responds, as usual, by removing his receiver from hook H. This automatically cuts out his bell and throws his telephone into the circuit, and also breaks the circuit of telephone T'' by removing the contact 10 from springs *s'* s^2, thereby preventing telephone T'' from ringing or hearing during the communication, or as long as telephone T' is off the hook H.

Case II: Central office desires to communicate with telephone T''. Operation in central office is the same as before, except that button — is used, putting copper to earth and zinc to line, and causing a — current to pass through the coarse wire of coils M M. Armature *n* is thereby affected, so that the end formerly attracted is now repelled by cores of M M. Screw *d* now makes contact with and removes spring *b* from its contact with screw *d'*, and severs the connection between screw *c* and spring *a*, allowing the latter to rest in contact with screw *c'*. Central office now signals as before, when the currents pass through coarse-wire coils of M M, and then by spring *b* and its connections to and through generator G', (the bell of which they cause to ring,) and to earth at P''. No movement of armature *n* occurs, because, as before stated, the effect of the currents passing through the coarse coils and the currents they induce in the fine-wire coils of M M are balanced. Telephone T'' responds by removing the receiver from hook H', which, while it performs the switching necessary for talking, also breaks the line of telephone T' by severing the connection between spring s^5 and hook H', thereby preventing the latter from ringing or interrupting or hearing the communication.

Case III: Telephone T' desires to communicate with central office. When the armature *n* happens to be in the position shown in drawings—*i. e.*, in contact with spring *a*—the currents from generator G go direct to central office without affecting any part of the automatic commutator. When the armature *n* happens to be in contact with spring *b*, while spring *a* is separated from it, but in contact by screw *c'* with the fine-wire coils of M M and the auxiliary electro-magnet B, then the alternating currents from generator G must cause the armature *n* to reverse, thus placing spring *a* in contact with the armature *n*, and at the same time to signal the central office. When generator G is put in motion by turning the crank in usual manner, the alternating currents then generated start from earth at P'' to hook H', out by spring s^5, binding-post L', contacts 6 7 5, binding-post B, generator G, spring s^3, hook H, to binding-post A, spring *a*, contact-screw *c'*, to tap connection *y*. From this point the currents have two paths to follow—one, of high resistance, through the fine-wire coils *w*, to tap *z*, the other, of very low relative resistance, to screw *f*, armature *e*, to tap *z*, and from this point through the coil B to binding-post E', to spring s^2, contact 10, spring *s'*, to earth at P'. When the currents arrive at *y*, almost the entire amount passes by screw *f*, armature *e*, and tap *z* through the coils B, on account of this being by far the shorter path, and the small amount of current which passes through the fine-wire coils M M is too weak to affect the armature *n*. The currents in passing through electro-magnet B cause armature *e* to be attracted, thus opening the circuit at screw *f*, and causing the entire current to take the other path through the fine-wire coils of M M, as before described. Should the first current not be in the required direction, it will only draw the armature *n* more strongly to the side it is on; but the next current, which must be in the required direction, will cause the armature *n* to reverse its position, thus putting the spring *a* in connection with armature *n*, and therefore in direct connection with central office, while the connections from screw *c'*, including auxiliary electro-magnet B and fine-wire coils of M M, are thrown out of circuit, and the balance of the currents pass to central office and are employed in giving the signal there. Armature *e* returns to its position in contact with screw *f* as soon as the currents cease to traverse the coil B.

Case IV: Telephone T'' wishes to communicate with central office. Generator G', with earth at P'', produces alternating currents, which flow into automatic commutator at L^2, passing by contacts 1 8 2 to spring *b*. As in Case III, should the armature *n* already be in proper position, the signal goes direct to central office; but should it be in the position shown in drawings, then the same action occurs as described in Case III—viz., the currents pass through coil B, breaking the circuit at *f*, and cause the currents to traverse fine-wire coils *w* of M M, throwing the armature *n* to other side and placing spring *b* in contact with armature *n* at screw *d*, the signal then passing on to central office.

Case V: Telephone T' wishes to communicate with telephone T''. Central office is signaled, as in Case III, and notified of the desire, whereupon manual switch C is turned by subscriber at T', at or near whose telephone the automatic switching apparatus is located, to the position shown in Fig. 3, connecting 4 and 5 with 1, and signal given by generator G or from central office, ringing both bells of generators G G'. Circuit is then from earth in central office to binding-post L, through coarse-wire coils of M M to armature *n*, spring *a* to binding-post A, to hook H, to spring s^3 for signal, or s^4 for speaking, to contacts 4 and 5 on 9, out by opposite side of 9 to 1, to binding-post L^2, bell and telephone at T'', by spring s^6 or s^7 to hook H, to earth at P''.

Case VI: Telephone T'' desires to communicate with telephone T'. Central office is signaled, as in Case IV, and notified of the wish. Central office then signals to telephone T', and instructs him to move manual switch to left and speak with T'', whereupon the circuit is same as in Case V.

When conversation is finished in Cases V and VI, the central office is notified of same as usual—*i. e.*, by ringing short signal—and manual switch C is restored to its former position by subscriber T'.

In general use two telephonic stations, located in same building or reasonably close together, will be selected to be placed on same wire as a matter of economy, in which case the cost of a second wire between the two will be of little consequence, a single wire running from central office to first telephone, T'. It may, however, happen that two stations at a distance from each other, but in same direction from central office, would be placed on one wire. Cost of a second wire between the two would then be considerable, and can be dispensed with by omitting the connections of binding-posts B and L′ and connecting the generator G with wire to post T, and also by disconnecting screw c′ and using it only as an insulated limiting-stop, so as to prevent T′ from interrupting the conversations of T″. This arrangement of circuits is shown in Fig. 3.

With the two-wire system it is immaterial to which side the armature n remains after being used; but if using only one wire between stations the central office must always place armature n in connection with spring a by means of a current of proper polarity after each communication. Should this be forgotten, the spring a would often be left insulated at c′, leaving line of telephone T′ open at that point, which would lead to much dissatisfaction.

In order to remove any chance of mistake by the operator in central office, and to render each station independent of the other, the two-wire system should be used where the distances are not too great.

The device at central office for throwing a current from M B onto line of one polarity or the other to set automatic switch may be of any suitable character. The double push-button shown in Fig. 2 may be used, each push-button controlling two sets of contacts, as clearly shown; or a circuit-reversing switch and a key may be employed, as shown in Fig. 3. The central-office telephone with magneto-call is shown at C T.

It is evident that the automatic switch is capable of use in any electrical system where the functions it is capable of performing will prove useful, as in telegraphy, messenger, fire-alarm, and burglar-alarm service, and in electric lighting.

What I claim is—

1. In a telephone system, the combination, with a single main line, of two sets of telephone-instruments and a polarized automatic switch for connecting either telephone with the central office, substantially as set forth.

2. In a telephone system, the combination, with a single main line, of two sets of telephone-instruments, a polarized automatic switch for connecting either telephone with the central office, magneto-generator calls, and a differentiating circuit neutralizing the alternating or intermittent call-currents at the automatic switch after the switch is set, substantially as set forth.

3. In a telephone system, the combination, with a single main line, of two sets of telephone-instruments, a polarized automatic switch for connecting either telephone with the central office, magneto-generator calls, a differentiating-circuit neutralizing the alternating or intermittent call-currents at the automatic switch after the switch is set, and a magnet opening the neutralizing-circuit to permit the setting of the switch by the alternating or intermittent call-currents, substantially as set forth.

4. A polarized switch provided with two sets of coils, one of which is in line and the other in a closed local circuit, such coils being proportioned so that alternating or intermittent currents in the line-coils will be neutralized in their magnetizing effect by the induced currents in the closed local circuit, substantially as set forth.

5. A polarized switch provided with two sets of coils, one of which is in line and the other in a closed local circuit, such coils being proportioned so that alternating or intermittent currents in the line-coils will be neutralized in their magnetizing effect by the induced currents in the closed local circuit, in combination with a magnet controlling said local circuit and opening it to permit alternating or intermittent currents to act on the polarized switch, substantially as set forth.

6. In a telephone system, the combination, with a single line from central office, of a polarized switch having one set of coils in said line, two contacts made alternately by the armature of said switch, two telephones connected, respectively, with said contacts, whereby a prolonged current of positive or negative polarity from the central office will shift said switch to connect one or the other of the telephones with the central office, and a local neutralizing-circuit at said switch to permit alternating or intermittent call-currents to be sent through it without disturbing its position, substantially as set forth.

7. In a telephone system, the combination, with a single line from central office, of a polarized switch-magnet having one set of coils in said line, two springs alternately in contact with the armature of said switch-magnet, two stationary contacts made by said springs when not thrown off by the armature, two telephones connected with said springs, a normally-closed neutralizing-circuit at said switch, connected with one or both of said stationary contacts, and a magnet for opening said neutralizing-circuit and throwing it into circuit with a magneto telephone-call, whereby the switch will be automatically set by the call-currents, and will then permit such currents to pass without disturbing it further, substantially as set forth.

8. In a telephone system, the combination, with a central office, of a single line therefrom, two telephones connected therewith, and an automatic polarized directing-switch located at one of such telephones for connecting the telephones separately with the central office, substantially as set forth.

9. In a telephone system, the combination, with a central office, of a single line therefrom, two telephones connected therewith, an automatic polarized directing-switch located at one of such telephones for connecting the telephones separately with the central office, and connections from the automatic switch through

the hook of one or of each telephone, for preventing interference by one telephone when the other is in use, substantially as set forth.

10. In a telephone system, the combination, with a central office, of a single line therefrom, two telephones connected therewith, an automatic polarized directing-switch located at one of such telephones for connecting the telephones separately with the central office, and a hand-switch at the same telephone for connecting said two telephones for communication between them, substantially as set forth.

11. In a telephone system, the combination, with the central office and the single line therefrom, of the differentially-wound polarized switch-magnet M, the local magnet B, hand-switch C, telephone sets T′ T″, and the connecting circuits, constructed and arranged for operation substantially as set forth.

This specification signed and witnessed this 11th day of June, 1886.

NICHOLAS CONRAD HEISSLER.

Witnesses:
EMIL AHLEFELDT LAURVIGEN,
ERNST DELACROIX.