

No. 684,316.

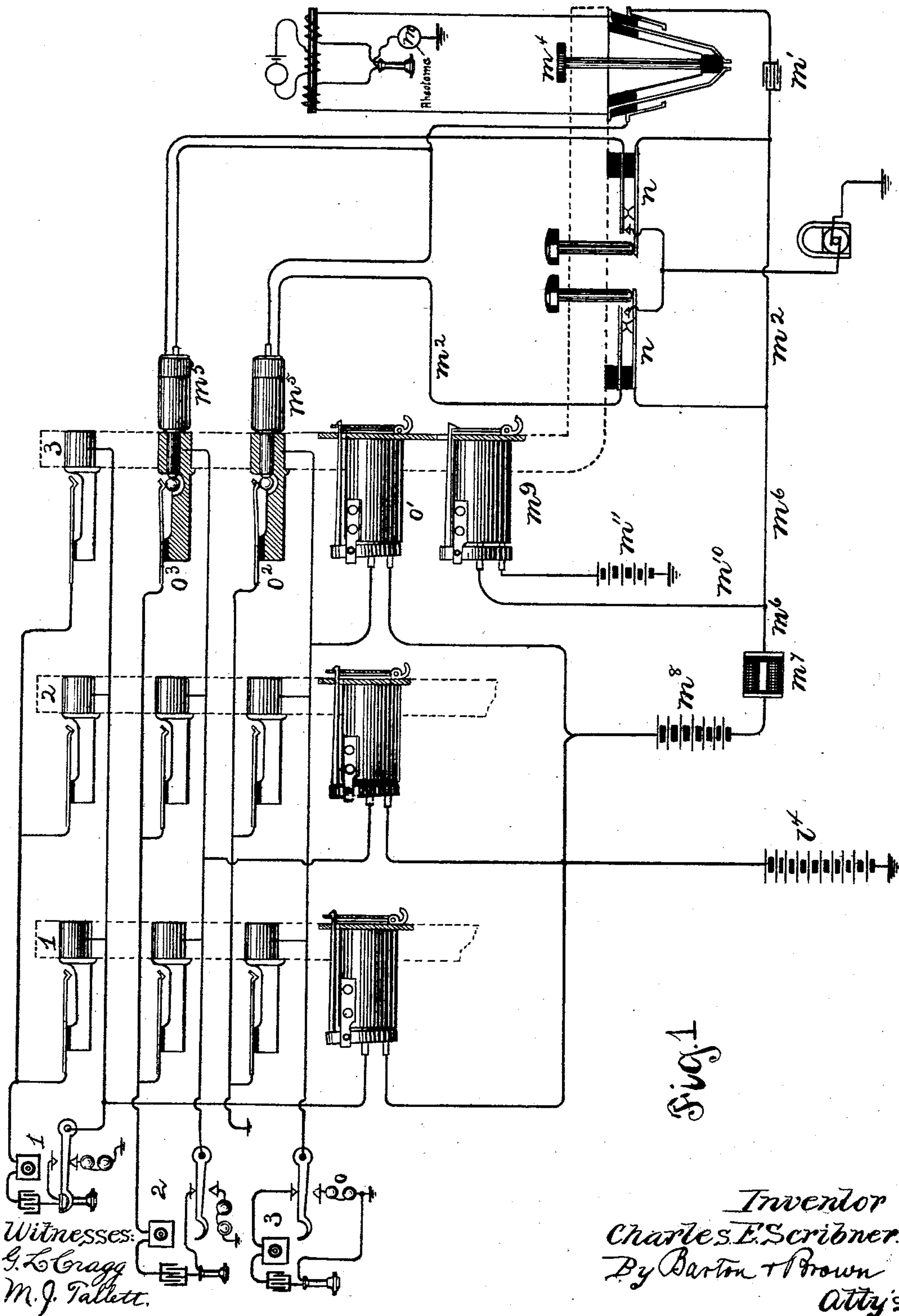
Patented Oct. 8, 1901.

C. E. SCRIBNER.
MULTIPLE SWITCHBOARD SYSTEM.

(Application filed Feb. 11, 1892.)

(No Model.)

2 Sheets—Sheet 1.



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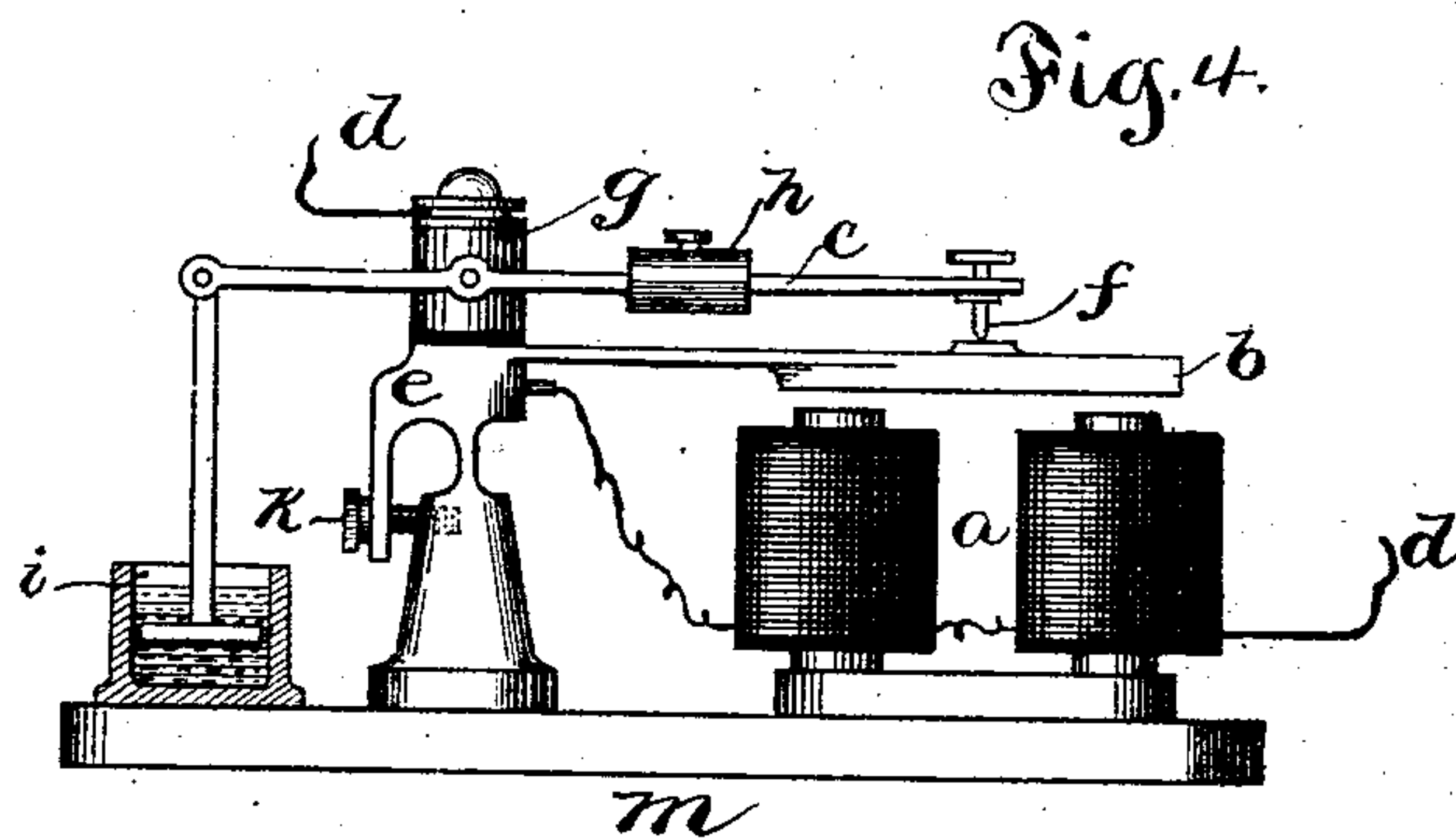
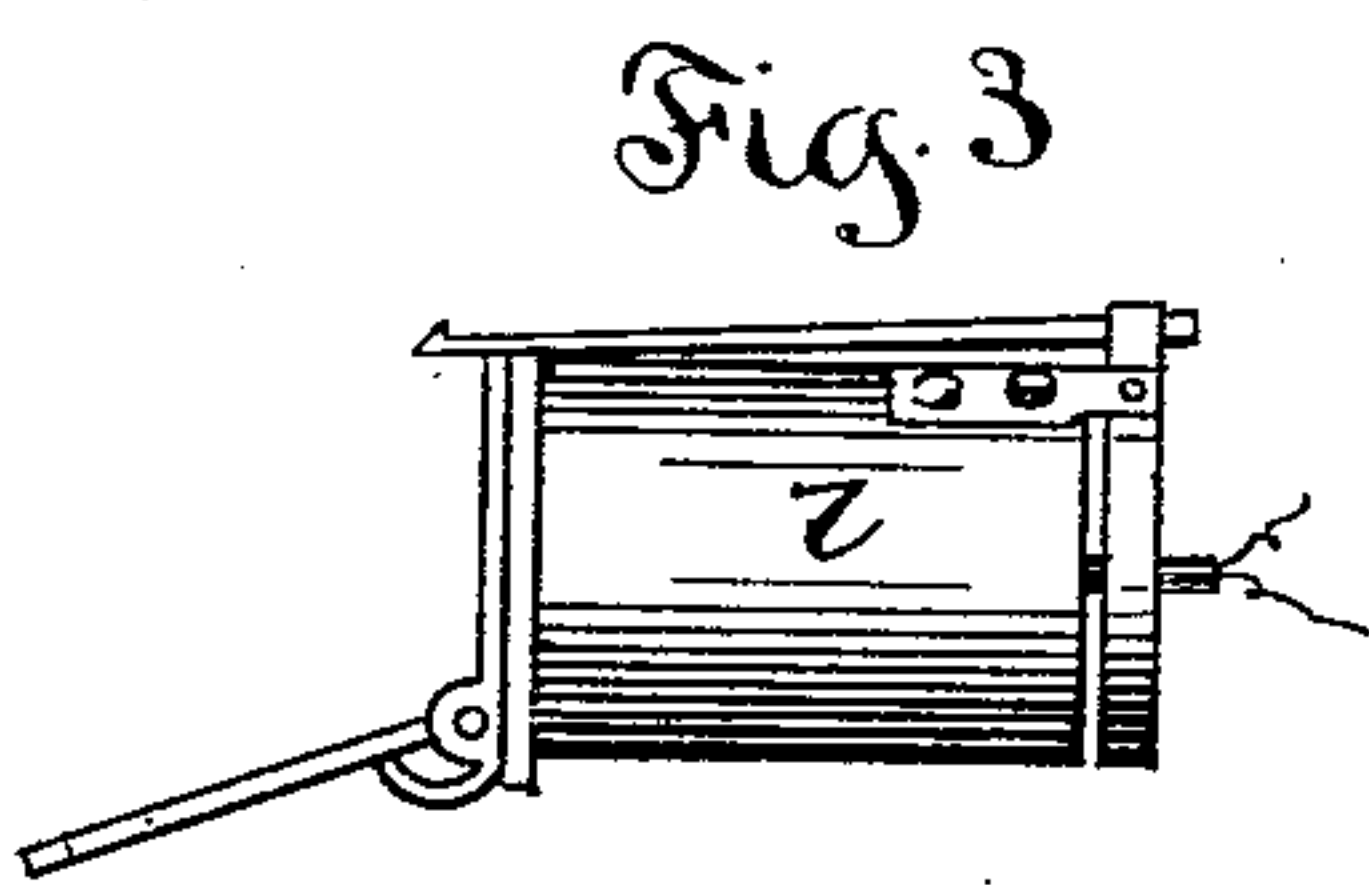
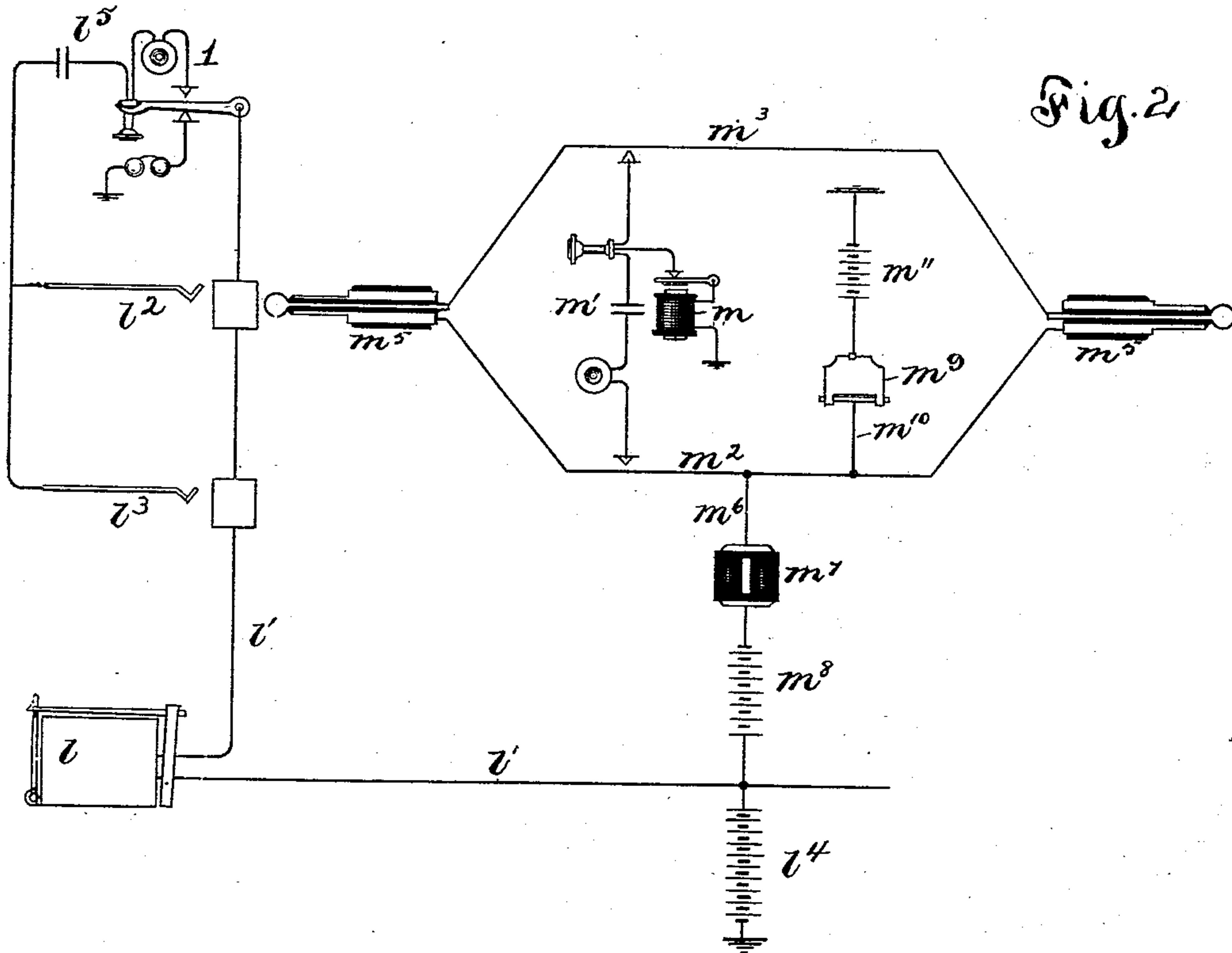
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Witnesses:
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UNITED STATES PATENT OFFICE.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

MULTIPLE-SWITCHBOARD SYSTEM.

SPECIFICATION forming part of Letters Patent No. 684,316, dated October 8, 1901.

Application filed February 11, 1892. Serial No. 421,173. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SCRIBNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Multiple-Switchboard Systems, (Case No. 284,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone-exchange systems and signaling devices adapted to be used in connection therewith.

Heretofore it has been common to provide a battery at the central office common to several lines, each line being provided with an individual annunciator so arranged that when the line of a particular annunciator is closed to ground at the subscriber's station current will pass through the said individual annunciator to hold the same up. On removing the telephone from the switch at the subscriber's station the switch, being relieved from the weight of the telephone, is carried away from its ground connection, so as to open the circuit of the line, and hence that of the individual annunciator. Thus the subscriber by simply removing his telephone from the switch throws down his individual annunciator to notify the office of his call.

Multiple-switchboard systems are now almost universally employed in large exchanges, and various systems of testing lines at one board to determine whether they are connected or in use at any other of the boards have been used in such multiple systems. In some one or more of these test systems apparatus and circuits are so arranged that the electrical condition of a line will be different when in use from what it is when idle—as, for example, a characteristic current may be thrown constantly upon all lines when idle, while the instrument causing the characteristic current will be cut off from any line when connected for use. My invention herein relates to these various prior systems of telephone-exchange, and consists, speaking generally, in the following features:

First. In connection with the operator's telephone I provide a rheotome of novel construction which when circuit is first closed

through it acts to interrupt the circuit and cause a buzz in the telephone, but by its own action soon becomes quiescent.

Second. My invention consists in combining a battery with the operator's outfit in such manner that when a line is connected said battery will be closed in local circuit through the individual annunciator of the line, so that after the operator plugs into a line and restores the annunciator by hand the battery thus closed through the annunciator will act to hold the annunciator up until the plug is removed.

Third. The clearing-out annunciator is arranged in a third-leg branch to ground from the sleeve-strand of the cord, this third-leg branch being provided with a source of current. When the telephone of a line is restored to its switch and restores the ground connection at the subscriber's station, current is sent over the circuit thus formed from the said battery to operate the clearing-out annunciator.

Fourth. Several telephone-lines after passing each through its individual annunciator are connected together and thence to earth through the main retaining-battery, while the local retaining-battery is connected with this same common wire and provided with branches, each branch extending through a different retardation-coil to the sleeve-strand of its particular pair of cords. The main retaining-battery and the local retaining-battery are of opposite polarity.

Fifth. In order that my invention may apply to mixed systems of telephone-exchange, I place in each line, preferably at the subscriber's station, a condenser, and I place also a condenser in the circuit of each operator's telephone, so that current may not pass from the sleeve-strand of the cord to the tip-strand thereof, and thus find circuit to ground, when a plug should be inserted in the switch of a grounded line at any board.

Sixth. The ringing-keys of the operators are of the continuity type in order that if a call should be sent over a busy line the individual annunciator thereof would not be thrown at a moment when the line would be open.

Seventh. The rheotome is provided with a

contact-point carried on a lever which tends to follow the armature-reed when the electromagnet of the rheotome is excited.

Eighth. My invention consists in the details of construction and combinations of parts hereinafter more particularly described, and specifically pointed out in the claims.

My invention will be more readily understood by reference to the accompanying drawings, in which—

Figure 1 is a diagram illustrative of three telephone-lines connected with multiple switchboards, together with circuits and apparatus embodying my invention. Fig. 2 is a more simple diagram illustrative thereof. Fig. 3 is a side elevation of an individual annunciator with the shutter thrown down. Fig. 4 is a side elevation of the rheotome.

Like parts are indicated by similar letters of reference throughout the different figures.

The rheotome, as shown in Fig. 4, consists, essentially, of the electromagnet *a*, the spring-pivoted adjustable armature *b*, the retarded pivoted lever *c*, having its contact resting upon the armature *b*, and the circuit *d*. The circuit *d* may be traced through the coils of magnet *a* to the post *e*, on which the lever *c* is mounted, and thence through said armature and the contact *f* of pivoted lever *c* to the binding-post *g* and out. The lever *c* is provided with the sliding weight *h* for the purpose of regulating the pressure of the contact of said lever *c* with the armature *b*. A dash-pot of usual construction is provided for retarding the downward movement of the free end of lever *c*, carrying the contact *f*. The armature *b* may be of soft steel, made thin, as shown, between the poles of the magnets and the post *e*, upon which the said armature is mounted, in order that the armature may be provided with a resilient support. Thus when the magnet *a* is excited the armature will be drawn down, and when the magnet is not excited the armature may be held by its support away from the poles, as shown. The upper portion of the post *e* is shown, below the connection of the armature *b* therewith, cut away and made thin, so that by means of the screw *k* passing horizontally through the downwardly-extending arm to the main body of the post the thin portion of the post may be flexed to adjust the position of the armature *b* with respect to the poles of the magnet *a*. It is evident that when the magnet is excited the anvil of the armature *b* will for a moment vibrate upon the contact *f*, and thus rapidly interrupt the circuit *d*, and in case the telephone is properly connected with the rheotome a buzz will be heard therein during the time that the contact *f* is in vibration. This vibration will continue only during the time the contact *f* is following the descent of the anvil. I preferably adjust the rheotome so that the buzz may continue for about two seconds. The adjustments are effected by means of the screw *k* and the weight *h*. A rheotome thus

constructed to interrupt the circuit for only a brief period after circuit is closed through the magnet thereof I believe to be new in the arts. This rheotome, while especially useful in connection with telephone-exchange systems, may be used for other purposes, and I therefore do not limit my claims herein in this regard to any specific use or organization of apparatus to be employed in connection therewith. Moreover, it is evident that the constructive details of my rheotome may be varied almost indefinitely by any one skilled in the construction of electrical apparatus. The individual annunciator shown in Fig. 3 is of that type in which the drop is retained only while the magnet *l* thereof is excited.

Referring to Fig. 2, it will be seen that the retaining-magnet *l* is shown included in the telephone-line *l'*. This telephone-line *l'* extends from the ground-contact, as shown at station 1, in metallic circuit to the central office, and after passing through the switches *l²* and *l³* and the individual annunciator *l* is connected with the battery *l⁴*, which I term the "main" retaining-battery, since many lines may be connected with the same battery. The current from this battery passing through individual annunciator *l* retains the drop thereof in the position shown in Fig. 2 until the subscriber at station 1 removes his telephone, whereupon the telephone-switch, actuated in the usual way by its spring, opens the ground-contact, and thus the circuit of the battery *l⁴* through individual annunciator *l* is opened and the drop falls to the position shown in Fig. 3, the falling of the drop being notice to the central office of the subscriber's call. I place a condenser *l⁵* in circuit with a telephone at a substation in order that my invention may be used in mixed systems of telephone-exchange.

In Fig. 2 the rheotome, in connection with the operator's telephone, is represented at *m*. In the bridge-wire containing the operator's telephone and transmitter I show a condenser *m'*. The telephone is bridged between the sleeve-strand *m²* and the tip-strand *m³* of the pair of cords by the usual listening-key. Such a listening-key *m⁴* is shown in Fig. 1. The plugs *m⁵* *m⁵* (shown most clearly in Fig. 2) are of usual construction and adapted to make connection with the spring and ring of a switch by the tip and sleeve, respectively, when inserted therein. Thus in Fig. 1 the lines of stations 2 and 3 are shown looped together at the last board by the pair of plugs *m⁵* *m⁵* and their cords.

It will be observed that the sleeve-strand *m²* of the pair of cords is provided with a branch *m⁶*, passing through a retardation-coil *m⁷*, and thence with the local retaining-battery *m⁸*, and thence to the line *l'*. Therefore when one of the plugs, as plug *m⁵* of Fig. 2, is inserted in a switch, as switch *l²*, the individual annunciator *l* will be connected in local circuit with local retaining-battery *m⁸*,

and thus the shutter, having been replaced by hand, will be held up. The clearing-out annunciator m^9 is placed in a third-leg connection or branch m^{10} , which is connected
 5 from the sleeve-strand through a source of current m^{11} to ground. Whenever the ground connection of a line that has been busy is restored at the subscriber's station, current from this battery m^{11} will be sent over the circuit
 10 thus formed, thus operating the clearing-out annunciator m^9 . Each of the telephone-lines of stations 1, 2, and 3 of Fig. 1 is connected to the central office, and each after passing through its individual annunciator is connected
 15 with the main retaining-battery l^4 , while the local retaining-battery m^8 is also connected to the common wire in which said telephone-lines unite, the branch m^6 , containing the retardation-coil m^7 , being connected
 20 to the sleeve-strand m^2 of the pair of cords. It should be observed that the main retaining-battery l^4 and the local retaining-battery m^8 have similar poles, connected together.

By referring to Fig. 2 it will be seen that
 25 when the subscriber removes his telephone from the switch the current through the annunciator l is stopped and the annunciator-drop falls. The operator on placing plug m^5 in spring-jack l^2 closes the circuit of battery
 30 m^8 through line l' , annunciator l , sleeve of plug m^5 , sleeve-strand m^2 , line m^6 , and retardation-coil m^7 , so that on replacing the annunciator-drop it will remain in position. It will be noticed that the sleeve-strand m^2 is
 35 connected to ground through the line m^{10} , so that the current from the battery l^4 would find a circuit to ground were it not for the battery m^{11} , which is so adjusted as to electromotive force that it just balances the elec-
 40 tromotive forces of the batteries l^4 and m^8 . So long, therefore, as the subscriber's telephone is removed from the switch there will be no current-flow through the annunciator m^9 and it will remain inoperative. When,
 45 however, the subscriber replaces his telephone upon the hook, a path to ground is opened for the current from batteries l^4 and m^8 , and the electromotive force balancing the battery m^{11} having been removed, the battery m^{11} will
 50 send a current through annunciator m^9 , sleeve-strand m^2 , sleeve of plug m^5 , and line l' to ground at subscriber's station. Thus it will be seen that the batteries l^4 , m^8 , and m^{11} are so adjusted and balanced that while the sub-
 55 scriber is using his telephone the only flowing current is that due to battery m^8 through the annunciator, sleeve-strand, and retardation-coil, the battery l^4 preventing flow of current to ground from the battery m^8 , and
 60 battery m^{11} preventing the same battery from sending current to ground through line m^{10} . When the subscriber replaces his telephone, this balance is destroyed and the annunciator m^9 is operated.

65 The ringing-keys n , which are connected with the sleeve-strand of the cord, so that current may be sent from the generator to

call up a subscriber, are of the continuity construction in order that the individual annunciator of a line over which a call-signal is
 70 being sent from the central office may not be thrown down at the moment when the line would be left open if a continuity-key were not employed.

The operation of my rheotome and a tele-
 75 phone-exchange system in which the same is employed is preferably as follows: Suppose subscriber at station 3 wishes to talk with subscriber 2 in the manner illustrated in Fig.
 1. Subscriber 3 by simply taking down his
 80 telephone opens automatically the ground connection o of his line and the circuit of battery l^4 through the individual annunciator o' of said line. The operator at the board where said individual annunciator o' is
 85 placed—in this instance board 3—seeing the shutter fall inserts one of his plugs m^5 into the switch o^2 of the line of station 3 and immediately restores the shutter of individual annunciator o' by hand. Immediately on the
 90 insertion of the plug m^5 into the switch o^2 the local retaining-battery m^8 will be connected in local circuit through said individual annunciator o' , so as to retain the shutter in position. This local circuit may be traced from
 95 said battery m^8 through said individual annunciator o' , included in the line of station 3, to the frame of switch o^2 , thence to the sleeve-strand m^2 of the pair of cords, and thence through the retardation-coil m^7 to the
 100 other pole of the battery. The operator now by operating her listening-key m^4 brings her telephone into circuit, and having received the order of subscriber 3 for the line of sub-
 105 scriber 2 touches the tip of the other plug m^5 of the pair of plugs to the test-ring of the switch o^3 of the line of station 2. Assuming that the line of station 2 is not busy or connected, the operator will hear no sound in her telephone when she makes the test. The
 110 adjustment of the rheotome m is such that there will not be sufficient current diverted through the magnets thereof to excite the same sufficiently to cause the relay to respond. The electrical circuit when a test is
 115 made may be most clearly understood by reference to Fig. 2. In said figure the telephone-line l is shown in its normal condition connected to ground through battery l^4 at the central office and also to ground at the sub-
 120 scriber's station. Assume that the operator connects her telephone in a bridge across the strands m^2 m^3 of the cords. Now let the tip of either plug m^5 be touched to the test-ring of any switch, as l^2 l^3 of line l' , we will say,
 125 for example, the ring of switch l^2 . There will be a derived circuit formed from said test-ring of switch l^2 to the tip of the plug, thence to the tip-strand m^3 , and thence through the telephone and the rheotome m to ground. The
 130 rheotome is, however, adjusted so that the current diverted from the test-ring to the tip of the plug and thence through the telephone and rheotome m to ground will not be suffi-

cient to operate the rheotome, and therefore no sound will be heard in the telephone—that is, referring back to Fig. 1 and assuming that the plug m^5 instead of being inserted in switch o^3 has its tip simply touching the frame of said switch, and assume, as before stated, that the listening-key m^4 is depressed to bring the telephone and the rheotome m of the operator at board 3 into the bridge between the strands of the pair of cords, and it may be properly assumed, further, that the telephone of subscriber's station 2 is hung upon the switch. Now it is evident that with the rheotome properly adjusted the current derived from battery l^4 will not be sufficient to operate the rheotome so as to cause a sound in the telephone, and the operator hearing no sound will insert the plug m^5 , as shown, in the switch o^3 . Then with the appropriate calling-key n the generator is thrown into the line of station 2 to ring the bell included in the circuit thereof at said station 2, whereupon the subscriber at station 2, taking down his telephone, is in communication with the subscriber at station 3, as shown. The individual annunciators of the lines connected will be retained by current from local retaining-battery m^8 . Moreover, the clearing-out annunciator m^9 will be connected in derived circuit to ground through battery m^{11} , included in the wire m^{10} , and, as before described, when either subscriber hangs up his telephone, and thereby closes the ground connection of his line, the circuit of battery m^{11} will be closed through clearing-out annunciator m^9 automatically. If a line tested is busy—that is, if the ground connection at the subscriber's station is not on when a test is made—it is evident that a considerable current from the battery l^4 , now serving as a test-battery, will be diverted through the telephone and rheotome m and the rheotome will respond and a sound will be heard in the telephone until the rheotome becomes quiescent.

It is evident that my invention admits of modifications in detailed construction which would readily suggest themselves to those skilled in the art, and I therefore do not limit myself to the precise forms of apparatus shown.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with an operator's telephone, of a branch through a rheotome adapted to cease making and breaking the circuit after an interval of time to ground, a battery in a circuit connected with a telephone-line and provided with a ground connection and switching apparatus, whereby the circuit through said rheotome, telephone and battery may be closed, said rheotome being adapted to interrupt the circuit and cause a buzz in the telephone, but by its own action soon thereafter to become quiescent.

2. The combination with a telephone-line, of a telephone branch circuit, a telephone and

a rheotome, adapted to cease making and breaking the circuit after an interval of time, said telephone and rheotome being contained in said telephone branch circuit, a battery and means for connecting said telephone-circuit and battery together and means for connecting the branch circuit containing the telephone and rheotome with the telephone-line, to determine the electrical condition of the line, as to whether or not the subscriber's line is connected with the battery.

3. The combination, with the opposing batteries l^4 , m^8 , one pole of l^4 being connected to ground, of telephone-lines having a common connection between the same, and including an annunciator, the local retaining-battery m^8 being branched through to the sleeve-strand of several pairs of cords, each such branch including a retardation-coil, the telephone-lines being normally closed to ground at the subscribers' stations thereon, substantially as and for the purpose specified.

4. The combination with several telephone-lines connected with multiple switchboards, of a condenser in each circuit at the subscriber's station, pairs of plugs and cords at the different switchboards, a branch telephone-circuit between the strands of said cords, a condenser in said telephone-circuit, whereby current may be prevented from passing from the sleeve-strand of the cords to the tip strand thereof to find circuit to ground when a plug is inserted in the switch of a grounded line at any board.

5. The combination, with a pair of cords, of a pair of continuity-keys connected with a calling-generator included therein, telephone-lines with which the cords are adapted to be connected, said telephone-lines including individual annunciators and a battery; whereby the individual annunciator of a line is prevented from being thrown down by current sent over a busy line at the moment when the calling-key is being operated.

6. In a rheotome, a contact-point carried on a lever, an armature-rod, which rod the contact-point on the lever is adapted to follow in the downward half of its vibration when the electromagnet of the rheotome is excited, a circuit including said contact-point and means for restraining the movement of the lever, whereby when circuit is closed through the rheotome the rheotome acts first to continuously make and break the circuit, after which the contact-point having come to rest upon the armature, the rheotome becomes quiescent.

7. The combination in a rheotome of the spring armature-lever b , the adjustably-weighted pivoted lever c , carrying a contact f included in the circuit of the rheotome; whereby said contact f is adapted to follow the movement of the armature b when the electromagnet is first excited to interrupt the circuit, substantially as specified.

8. In a rheotome, the combination with the electromagnet, of its armature and a contact-

piece normally held closed upon said lever and means adapted to continuously make and break the electrical connection between said contact and the lever for a time after the current is closed through the rheotome and to then close said contact to render the rheotome quiescent.

9. A telephone-circuit connected from between the main retaining-battery l^4 and the local retaining-battery m^8 through an individual annunciator and thence through the test-piece of each of two or more switches on different switchboards to a telephone-switch at a subscriber's station, said telephone-switch being provided with a normal ground branch through a bell to ground, the other connection of said telephone-switch extending through a telephone and condenser to the springs of the switches upon the switchboard, and a pair of connecting-cords with terminal plugs at each of the switchboards, the sleeve-strand of each pair of cords being provided with a branch through a retardation-coil to the local retaining-battery; whereby when the telephone is removed from the switch the individual annunciator is thrown down, while on inserting a plug of a switch of the line at either of the boards, a local circuit is closed through the individual annunciator to retain the same in position after the shutter has been restored, substantially as and for the purpose specified.

10. The combination with the subscribers' telephones and telephone-lines, of central-station apparatus, including a clearing-out annunciator or equivalent, batteries so disposed at the central station and so balanced as to electromotive force that, while a switch at the subscriber's station is open, said clear-

ing-out annunciator is inoperative, but upon closing said switch at the subscriber's station the balance of said batteries is destroyed and the clearing-out annunciator is simultaneously operated; substantially as described.

11. The combination with the subscribers' telephones and telephone-lines of switchboards, plugs and cords, and circuits at the central station, a battery and a clearing-out annunciator in a branch circuit from the sleeve-strand of the cords to ground, a battery between the test-rings of the switches and ground, a battery and retardation-coil between the test-rings and the sleeve-strands of the cord, said batteries being so adjusted and balanced as to electromotive force that said clearing-out annunciator is inoperative, a branch to ground at the subscriber's station, a switch at the subscriber's station adapted to be closed by the subscriber hanging up his telephone, to destroy the balance of the batteries and to operate the annunciator; substantially as described.

12. The combination with a telephone-line, of a ground branch therefrom including a battery, a second ground branch therefrom including an annunciator and a source of electromotive force in the branch with said annunciator exactly balancing the difference of potential between said line and earth due to the battery in the other ground branch, substantially as described.

In witness whereof I hereunto subscribe my name this 1st day of February, A. D. 1892.

CHARLES E. SCRIBNER.

Witnesses:

M. JEANE TALLETT,
GEORGE L. CRAGG.