No. 834,538. PATENTED OCT. 30, 1906.

H. D. STROUD.

SYSTEM AND APPARATUS FOR MEASURING TELEPHONE SERVICE.

APPLICATION FILED MAY 13, 1904.

3 SHEETS—SHEET 1.

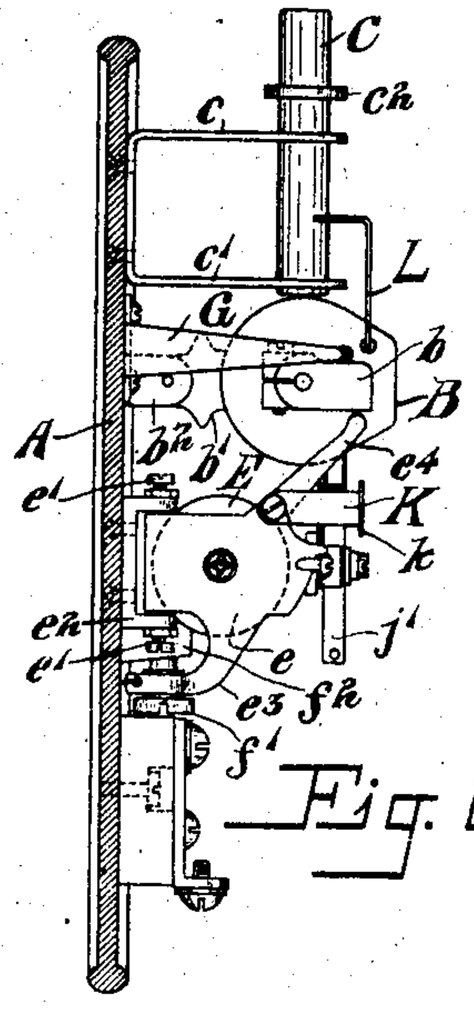

Fig. 2.

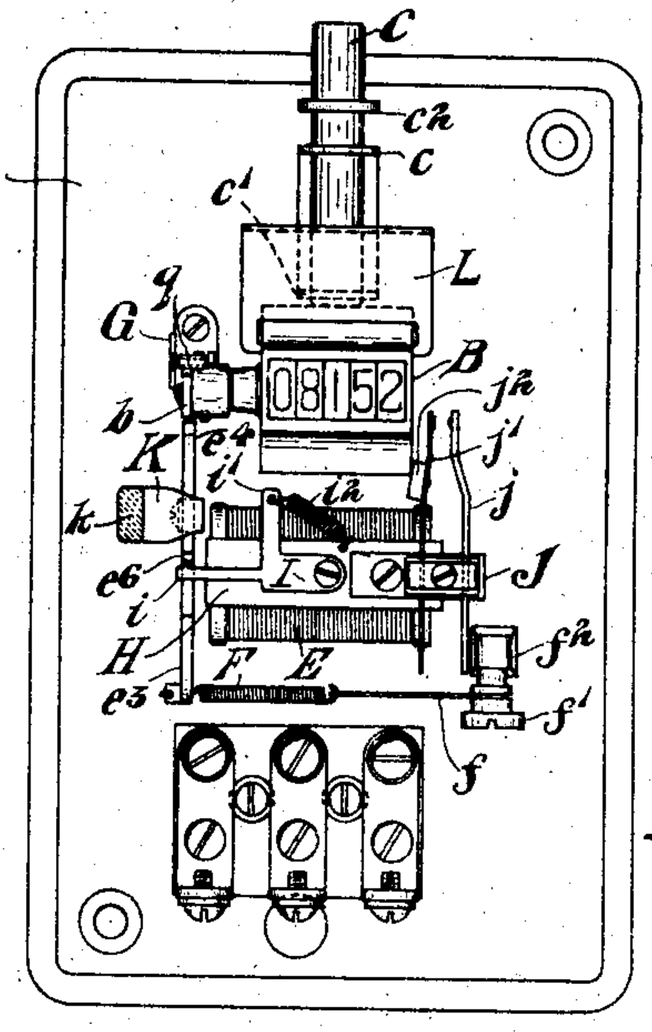

Fig. 1.

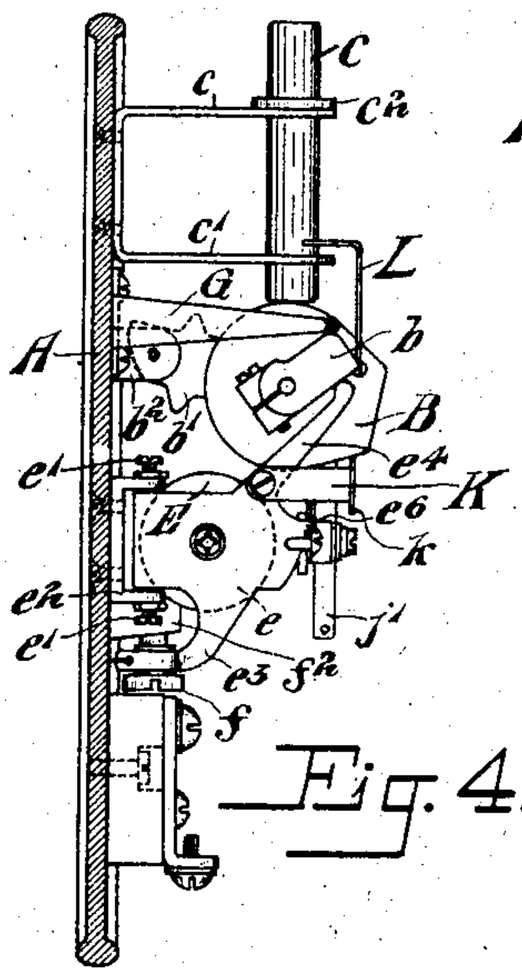

Fig. 4.

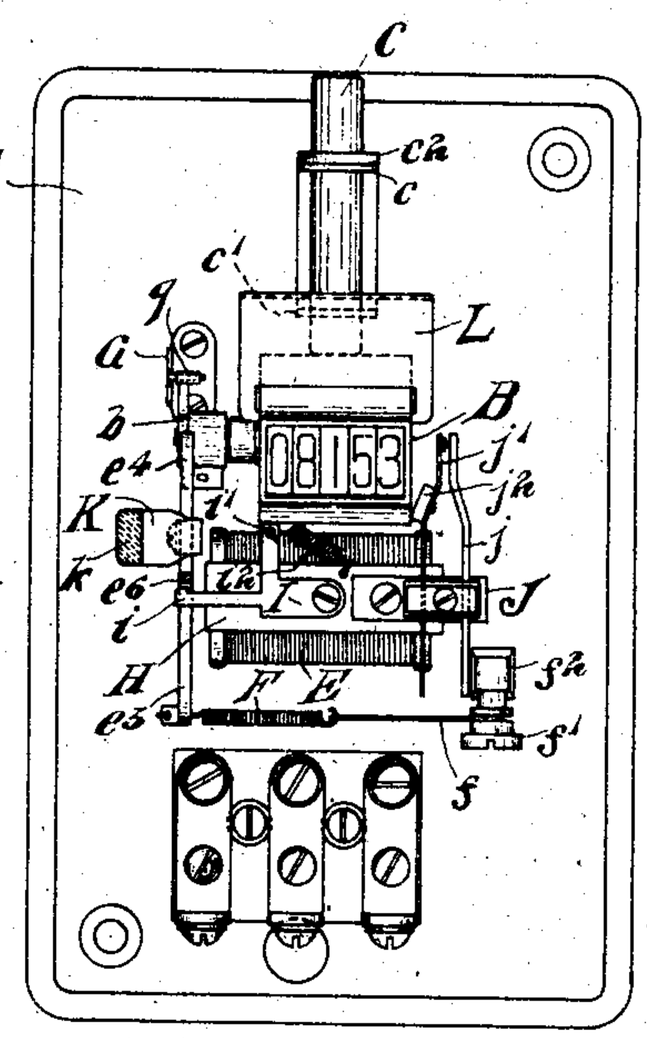

Fig. 3.

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3 SHEETS—SHEET 2.

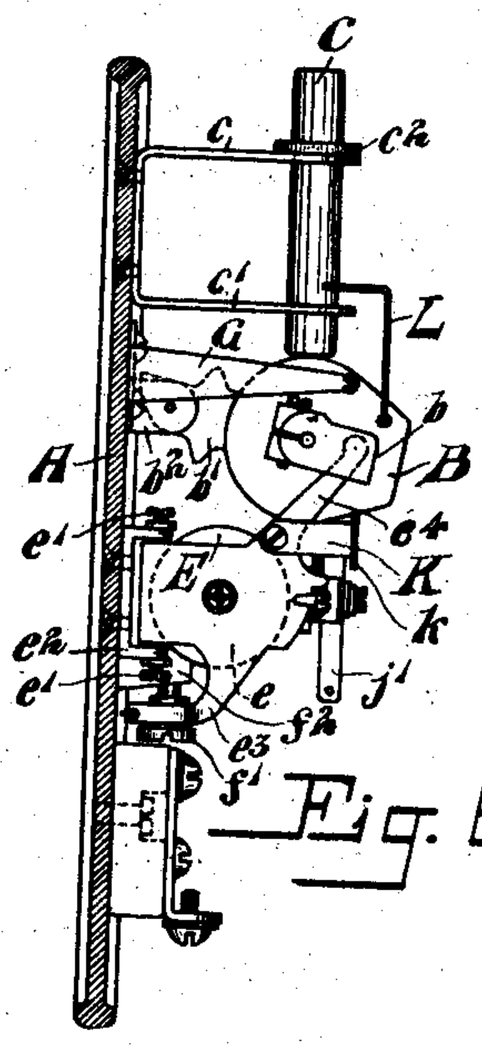

Fig. 6.

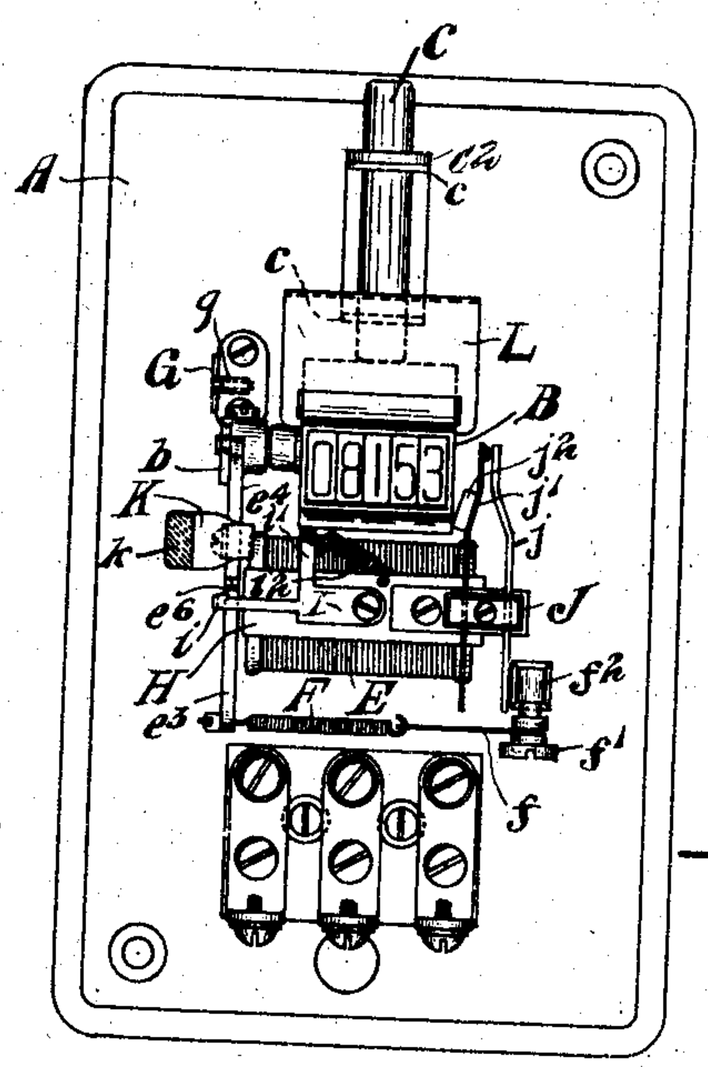

Fig. 5.

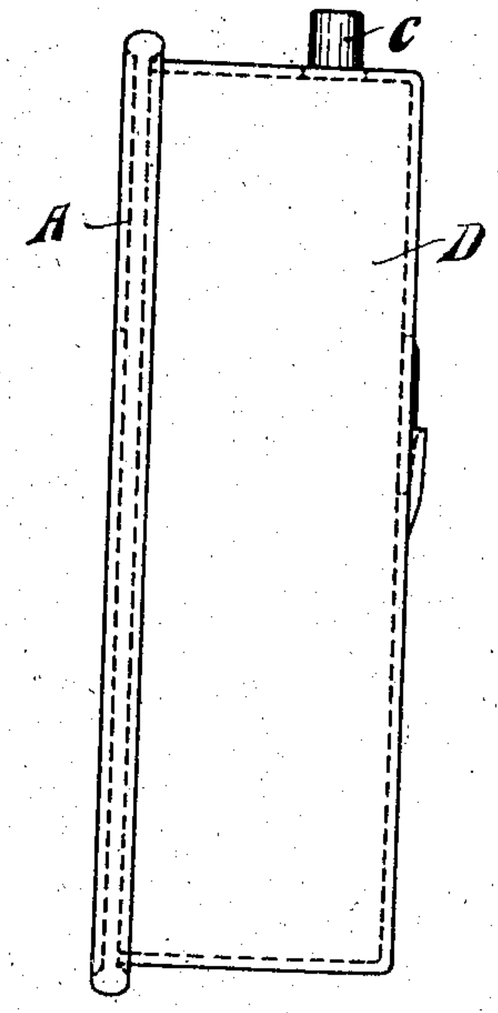

Fig. 8.

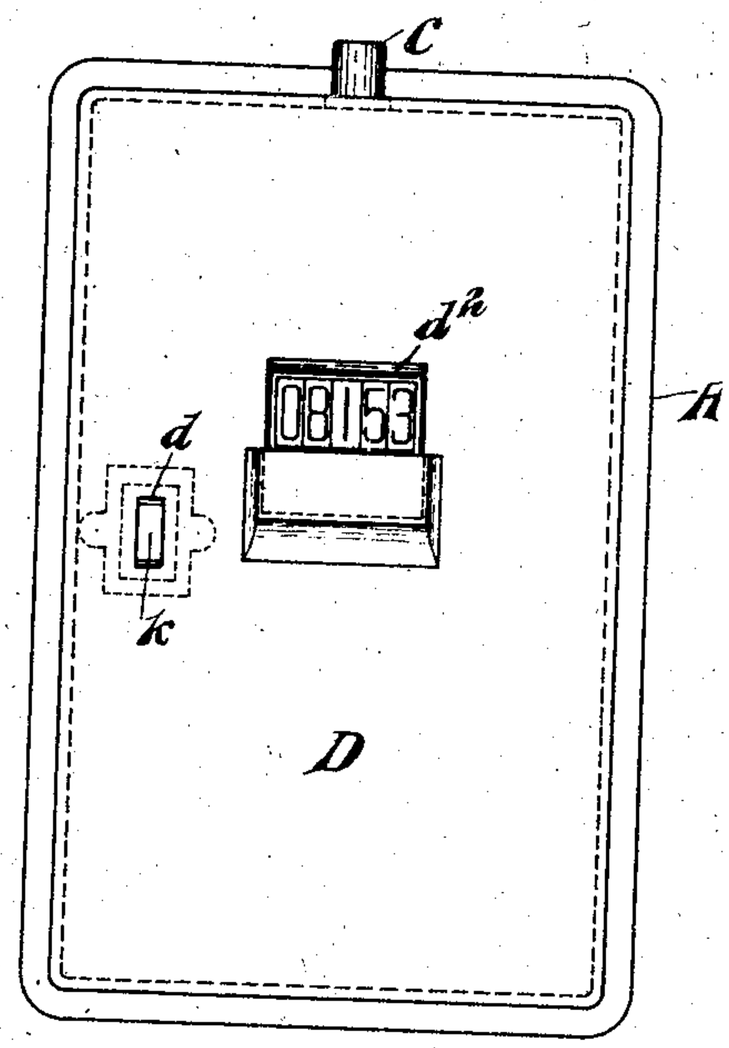

Fig. 7.

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3 SHEETS—SHEET 3.

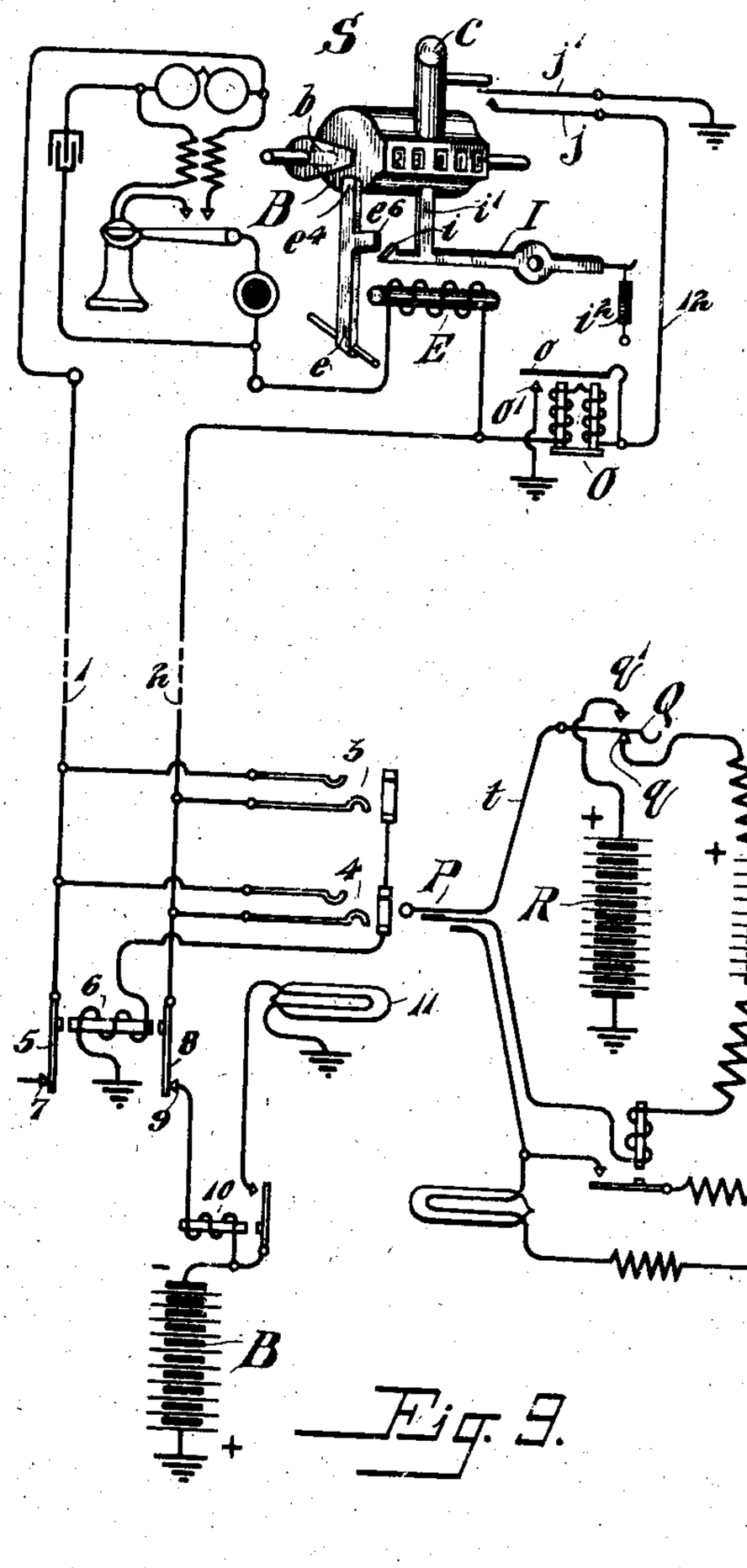

Fig. 9.

Witnesses.
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E. A. Gallock

Inventor:
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UNITED STATES PATENT OFFICE.

HAROLD D. STROUD, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE STROUD INTERNATIONAL MEASURED SERVICE COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

SYSTEM AND APPARATUS FOR MEASURING TELEPHONE SERVICE.

No. 834,538. Specification of Letters Patent. Patented Oct. 30, 1906.

Application filed May 13, 1904. Serial No. 207,876.

To all whom it may concern:

Be it known that I, HAROLD D. STROUD, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Systems and Apparatus for Measuring Telephone Service, of which the following is a specification.

My invention relates in general to improvements in that class of telephone systems wherein the telephone user is charged for service on the basis of the amount he uses his telephone. This class of systems may be broadly termed "measured-service" systems, in contradistinction from those termed "flat-rate" systems, wherein a fixed rate is charged regardless of the amount of the use of the telephone.

My invention relates particularly to that class of devices adapted to be associated with subscribers' equipments in telephone-exchanges for the purpose of registering the number of times the telephone is used, the reading of the register determining the amount of charge to be made for the use of the telephone.

In some devices for this purpose heretofore proposed the call-registering device registers all calls made by the subscriber, whether such calls result in the desired connections or not. This, in view of the fact that some calls are necessarily not successfully terminated, results in an overcharge to the subscriber. In other devices only those calls which are successfully terminated are registered on the device at the substation. This is done by a special act on the part of the operator at the central office, who by means of an electromagnet under her control causes the apparatus at the substation to register one count after the two parties have been brought together for conversation. This method makes possible an equitable charge; but it results in an unnecessary drag on the speed of the operator, it being necessary for her to watch each connection and manipulate the counter when the called-for party responds.

It is the purpose of my invention to afford a counter or meter which will accomplish the measuring of telephone service on a strictly equitable basis and at the same time result in practically no drag on the speed of the operator. To this end I so arrange the recording device that it will record a charge for all calls, whether successfully terminated or not, and I further provide means not under the control of the user of the telephone to register a credit for a call in case the call is unsuccessful.

A further object of my invention is to produce a telephone-service meter of greater reliability than any heretofore used, this reliability being not only from the standpoint of accuracy in counting, but also from that of low cost of maintenance.

In the operation of my meter some act on the part of the subscriber that it is necessary for him to perform in order to secure the attention of the central-office operator also serves to register a count on the meter. This preliminary requirement on the part of the subscriber may be the operation of a generator-crank, the turning of a key, the moving of a switch, the pressure of a push-button, or other similar act which may be required in order to call the central office in the exchange in which it is desired to use the invention. Since the act of calling results in the registration of a count on the meter, the operator concerns herself in no wise with the registration of the meter, as she knows that the meter must have been properly actuated before the call could have been made. In order, however, to prevent the registration of all calls from resulting in an overcharge to the subscriber, I so construct my meter that in the case of an unsuccessfully-terminated call the operator at the central office has it in her power to credit a call to that station, this being accomplished by electromagnetic means controlled over the circuit of the line. This method of crediting a call may be accomplished by the operator having under her control a magnet at the substation-meter which when energized will not turn the meter-counter back, but will place it in such condition that the subscriber will receive the next call without causing his meter to register.

Referring now to the accompanying sheets of drawings, in which the characters refer to the same parts throughout, Figure 1 shows a front view of the mechanism of my meter in its normal position, the front cover having been removed. Fig. 2 shows a side elevation.

partially in section, of the apparatus in the same position. Figs. 3 and 4 show, respectively, a front and side view of the mechanism when in the position it occupies while a call is being made. Figs. 5 and 6 are respectively front and side views of the mechanism after the crediting-magnet has been operated, showing the apparatus in condition to give a free call. Figs. 7 and 8 are respectively front and side views of the apparatus complete with the cover in place. Fig. 9 is a diagraphic representation of a line-circuit of a telephone-exchange equipped with one of my meters.

Referring now particularly to Figs. 1 and 2, A is a base-plate upon which all parts of my meter are mounted, this being preferably of metal, stamped or cast.

B is the meter proper, which may be of any well-known type, adapted to register one count for each mechanical impulse given to its controlling part or lever. A lever *b* is attached to the main shaft of the meter, by means of which said shaft may be rotated through a limited angle with respect to the casing of the meter, thus causing one count upon the register for each such movement of the shaft. The body of the meter B is mounted on the arm *b'*, which may, and preferably does, form an integral part of the casing of the meter. This lever is pivoted in a bracket b^2, secured in any suitable manner to the base-plate A. By means of a pivotal connection between the meter proper and the bracket b^2 the meter as a whole may be moved up and down through a considerable arc. It is obvious that if the lever *b* were free to move with the meter when so swung on its pivot no registration would be effected on the meter. If, however, when the meter is swung downwardly and back to its normal position the outer end of the lever *b* is held practically still, one count will be registered in the same manner as if the meter proper had been held still and the lever swung with respect to it. It is on this principle that I secure the registration or non-registration of the meter.

C is a rod, preferably of hard rubber or similar material, supported and adapted to slide in the two guides *c c'*, secured to the base A. The end of this rod projects through an opening in the cover D of the meter, thus forming a convenient push-button by means of which the subscriber may manipulate the meter. The flange c^2 on the rod C serves to limit the downward motion of the push-button rod by engaging the upper support *c* and also to limit the upward motion of this rod by engaging against the inside face of the box D. The lower end of this rod rests against the upper face of the meter, and the downward pressure of the rod is therefore communicated to the meter in an obvious manner.

E is an electromagnet having an armature *e* at its left-hand end pivoted by means of trunnion-screws *e' e'*, carried in a bracket e^2, mounted on the base A. This armature has an extension e^3 extending to a point beyond the line of the pivotal axis on which the armature swings, at which point is secured a coil-spring F, which tends to retract the armature from the pole-piece of the magnet. The tension of this spring may be adjusted by means of a thread *f*, one end of which is wrapped about a screw *f'*, adapted to turn in a block f^2, secured to the base A. The armature *e* also has an upward extension e^4, which in the normal position of the apparatus, Figs. 1 and 2, rests directly within the path of a lever *b* of the meter B. When in this position, no downward movement of the outer end of the lever *b* will take place when the meter proper is depressed by the action of the rod C, such movement being prevented by the presence of the arm e^4 of the armature *e*. The lever *b* is therefore moved with respect to the meter-case B, and therefore a count is registered. When the pressure on the rod C is released, the meter resumes its normal position, the arm *b* being held from upward movement by the bent arm *g* of the bracket G, which lies within the upward path of the lever. If the magnet E is energized, so as to attract the armature *e*, the arm e^4 would be moved to the right of the path of the lever *b*, as is shown in Fig. 5, and therefore with the armature held in its attracted position a downward movement of the meter would cause no registration, because the arm *b* would then be free to move with the meter B.

Directly in front of the coil of the magnet E, mounted on a plate H, is a latch-lever I, carrying at its left-hand extremity a catch *i*, adapted when in its normal position to catch and hold the armature *e* when that armature is attracted by the energization of the electromagnet. When the electromagnet is traversed by a current of sufficient strength, its armature is attracted and the projection e^6 on the armature engages the catch *i*, and the armature is held in this position until released by said catch. The latch-lever I is also provided with an upwardly-extending arm *i'*, engaged by a coil-spring i^2, which spring serves to hold said latch-lever normally in the proper position to engage the extension e^6 on the armature. When, however, the meter B is depressed by pressure on the rod C, it engages the upwardly-extending arm *i'*, thus moving the catch *i* downward against the tension of the spring i^2, thus releasing the armature *e* if it were at the time retained by the latch.

Mounted at the right-hand side of the electromagnet E on the base J is a pair of spring contacts *j* and *j'*, insulated from the base A and normally from each other. The spring

j' carries an insulating-block j^2, which normally lies within the path of the right-hand portion of the meter B, its position being such that when said meter is depressed the spring j' will be forced thereby into electrical contact with the spring j. The two springs are so connected in relation to the other apparatus of the telephone system, as will be shown, that the circuit thus closed by them will cause the illumination of the lamp or the display of the line-signal at the central office.

Mounted on the armature e is a metal strip K, carrying on its front face a target or signal k. This signal lies close to the inside front surface of the box D and when moved by the armature assumes a position directly behind the hole d in the front of this cover. It thus serves when displayed as an indication to the subscriber that the credit-magnet has been operated and that therefore he will receive his next call without causing the meter to register. The large rectangular hole d^2 in the front of the box-cover D affords means for viewing the face of the meter, the meter-face lying directly behind this hole when the meter is in its normal position. A metal shield L, pivotally secured to the meter-case B, partakes of the vertical motion of the meter when actuated, and this closes the hole d^2 in the cover D when the meter is moved downward by the action of the button C. By this means the hole d^2 is closed whenever the meter is moved from behind it, and thus meddlesome persons are prevented from interfering with the interior of the box.

In Fig. 9 is shown a circuit diagram of a telephone-line connecting a subscriber's equipment to a central-office equipment. The arrangement of talking and call-receiving apparatus shown at the substation in this figure is one in wide use, as is also the form of switchboard at the central office. This view also shows a portion of the cord-circuit used at the central office, which is of a type well known to those skilled in the art. In this figure, 1 and 2 represent the two limbs of the metallic-circuit line extending from a subscriber's station S to a multiple switchboard at the central office. In this the jacks 3 and 4 are associated with the line-circuit in a manner well understood in practice. The limb 1 of the line extends to one of the contact-levers 5 of the cut-off relay 6; but the back contact 7 of this relay, instead of being connected to ground, as is done in ordinary practice, is left open. The limb 2 of the line passes to the other contact-lever 8 of the cut-off relay, thence under normal conditions to the back contact 9, through the coil of the line-relay 10, to the negative side of the battery B, the positive terminal of which is grounded. A lamp 11 is connected in the local circuit of the relay 10, so as to serve as a line-signal, in a manner well understood.

The apparatus at the subscriber's station consists of the well-known call-receiving bell and the usual talking apparatus and hook-switch.

Associated with the line-circuit at the subscriber's station in the manner shown are the various parts of my service-meter, the coil of the credit-magnet E, which is used to credit a count to the subscriber in the case of an unsuccessful call, being placed directly in series with the limb 2 of the line. Connected with the limb 2 of the line is the coil of a relay O, the other terminal of which is connected by a wire 12 to the contact-spring j of the meter. The corresponding contact-spring j' is connected to ground. When, therefore, the meter is operated by pressing the rod or button C, the circuit from the limb 2 of the line is closed to ground by the springs $j\,j'$, this circuit including the coil of the relay O. The armature o of the relay is connected with the wire 12, while the front contact o', which this armature engages when attracted, is connected to ground.

The cord-circuit of the central office is the same as that in wide use with the exception that the key Q is so associated with the tip-strand t of the answering-plug P that the normal connection closed in talking may be broken at the contact q of this key and another at contact q' closed, by which means the battery R, of approximately ninety volts, is connected between the tip-strand t and ground. The operation of this circuit may now be understood. By virtue of the back contact 7 of the relay 6 being left open at the central office the subscriber cannot attract the attention of the operator by merely taking the receiver from its hook. He must therefore depress the button C, thereby momentarily closing the contact $j\,j'$ and completing a circuit, which may be traced from the negative side of the battery B at the central office through the coil of the relay 10, contacts 9 and 8, respectively, of the cut-off relay, to the limb 2 of the line, thence through the coil of the relay O, the wire 12, and the springs $j\,j'$ in the meter to ground, and to the positive side of the battery B at the central office. Were it not for the relay O at the subscriber's station the pressure of the button C would cause but a temporary action of the line-relay and the corresponding flashing of the lamp 11, as the circuit would be opened as soon as the subscriber released the button. The relay O is, however, energized by this passage of current, and attracting its armature it closes another circuit to ground through the contacts $o\,o'$. This latter circuit is held closed as long as the relay O receives current. As the line-relay 10 is in the same circuit, it remains energized, and therefore the lamp 11 remains lighted. As soon, however, as the operator in response to the signal inserts the answering-plug P into one of the line-jacks the cut-off relay 6 is ener-

gized, thus cutting off the circuit through the line-relay 10 and causing the lamp 11 to go out. The relay O being deprived of current its armature drops back, thus removing all ground connections from the line at the subscriber's station. The same pressure on the button C that was made in order to call the central office also caused the registration of one count on the meter unless the magnet E had been previously energized. The operator therefore under this plan does not need to concern herself as to whether the subscriber has properly operated his meter or not, for it is known that the call could not have been made without such action on his part. The operator therefore proceeds to make up the connection in exactly the same manner as if the subscriber were being charged on the flat-rate basis, and if she is able to secure the party called for she completes the connection without special work. If, however, for any reason she is unable to secure the party called for, she will, by means of key Q, connect the battery R with the tip-strand *t* of the answering-plug P, and the circuit may then be traced from the positive side of this battery to the contact *q'* of the key Q, the tip of the plug P, limb 1 of the line, thence through the subscriber's talking apparatus to the coil of the return-magnet E, and back by means of the limb 2 of the line to the sleeve contact of the jack and plug, thence to the negative side of the battery B to ground and to the negative side of the battery R. The two batteries R and B are thus put in series, thereby subjecting the circuit traced to a potential of approximately one hundred and ten volts. This is sufficient to operate the magnet E, which is inert to the currents normally traversing the line from the twenty-volt battery B.

The energization of magnet E causes the projection e^6 of the armature *e* to move into engagement with the latch *i*, where it is held. In this position of the armature the signal *k* is displayed to the subscriber, and he knows, therefore, that he will receive his next call free. When the button C is next depressed for the purpose of sending another call, the arm *b* moves downward with the meter, the end e^4 of the armature *e* being out of its path. For this reason the meter does not register; but the meter itself by pressing against the arm *i'* of the lever I releases the catch *i* and allows the armature *e* to spring into its normal position, so that unless the crediting-magnet E is again operated the next call will be registered.

The magnet E is so adjusted that it will not attract its armature when its coil is traversed by currents from the twenty-volt battery used in the normal operation of the exchange. Its winding is, moreover, of such a nature as to make the magnet irresponsive to alternating currents, and therefore when calling-current is sent out on the line of a calling subscriber equipped with one of my meters no effect whatever is produced on the crediting-magnet. This magnet, the relay O, and the entire meter mechanism perform no function when the station with which they are associated receives a call.

I do not wish to limit myself in all respects to the exact construction or circuit connections here shown, as it is obvious that changes in the details of construction, connections, or in the method of operation may be made without departing from the spirit of my invention.

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

1. In a telephone-service meter, a registering device, means adapted to be actuated by a telephone user to cause said registering device to charge a call, and means under the control of the telephone operator for causing said registering device not to charge a call on the next succeeding actuation by the telephone user, substantially as described.

2. In a telephone-service meter, a registering device, means adapted to be actuated by the telephone user in making a call to cause said registering device to record one count, an electromagnet adapted when energized to cause said registering device not to record one count when said means is actuated by the telephone user in making the next succeeding call, substantially as described.

3. In a device for vending service, a meter adapted to be actuated by the patron in obtaining service to register a charge for service, and means under the control of the vendor to cause said meter not to register a charge for service when actuated by the patron when next obtaining service, substantially as described.

4. In a meter for telephone service, a counter, means whereby a telephone user may cause said counter to register a charged call, an electromagnet associated with said counter, a telephone-line extending to a central office, means at said central office for energizing said magnet to cause said counter not to register a charged call when said registering means is next operated by the telephone user, substantially as described.

5. In a telephone-service meter, a counter, means whereby a telephone user in sending a call causes said counter to register, an electromagnet associated with said counter, means controlled by said magnet to prevent said counter from registering when a call is sent, a telephone-line extending to a central office, and means at said central office for energizing said magnet, substantially as described.

6. In a telephone-service meter, a counter, means actuated by a telephone user in sending a call to cause said counter to register, an electromagnet associated with said counter,

an armature for said magnet adapted while in its attracted position to render said meter inoperative, a latch-lever adapted to retain said armature in its attracted position, and a device for causing said latch-lever to release said armature after a call has been sent thus rendering said counter operative to subsequent calls, substantially as described.

7. In a telephone system, a call-registering device at a subscriber's station, a telephone-line connecting said subscriber's station with a central office, a source of current and a signal at said central office, said signal being adapted to respond to current flowing over said line from said source, a pair of contacts at said substation actuated by said registering device to momentarily close said line-circuit to actuate said signal, and a locking-relay energized by the initial flow of current through said pair of contacts to close a shunt-path around said contacts to maintain the display of said signal, substantially as described.

8. In a telephone system, a call-registering device at a subscriber's station, a metallic-circuit telephone-line connecting said subscriber's station to a central office, a source of current and a signal-receiving device connected between one limb of said line and ground at said central office, a pair of contacts in said call-registering device closed when said registering device is actuated to momentarily complete the circuit between said limb of the line and ground at said substation, and a locking-relay at said substation actuated by the initial flow of current through said pair of contacts to close a shunt-path around said contacts to maintain the display of said signal, substantially as described.

9. In a telephone system, a call-registering device at a subscriber's station, a metallic-circuit telephone-line connecting said subscriber's station to a central office, a source of current and a signal-receiving device connected between one limb of said line and ground at said central office, a pair of contacts in said call-registering device closed when said registering device is actuated to momentarily complete the circuit between said limb of the line and ground at said substation, a locking-relay at said substation actuated by the initial flow of current through said pair of contacts to close a shunt-path around said contacts to maintain the display of said signal, and a relay at said central office operated when connection is made with the line to open the circuit through said signal-receiving device and locking-relay, substantially as described.

10. In a telephone system, a call-registering device at a subscriber's station, a device to cause said call-registering device to credit a count, a metallic-circuit line connecting said substation with a central office, a source of current and a line-signal at said central office, a pair of contacts in said call-registering device adapted, when said registering device is actuated, to cause the momentary operation of said line-signal, a locking-relay at said substation actuated by the initial flow of current through the line to maintain the display of said signal, a magnet in said call-registering device adapted, when actuated, to credit a count, an auxiliary source of current at said central office and means at the central office to cause current from said auxiliary source to energize said magnet, substantially as described.

Signed by me at Chicago, county of Cook, and State of Illinois, this 31st day of March, 1904.

HAROLD D. STROUD.

Witnesses:
E. A. GARLOCK,
KEMPSTER B. MILLER.