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N. H. HOLLAND.

TELEPHONE METER.

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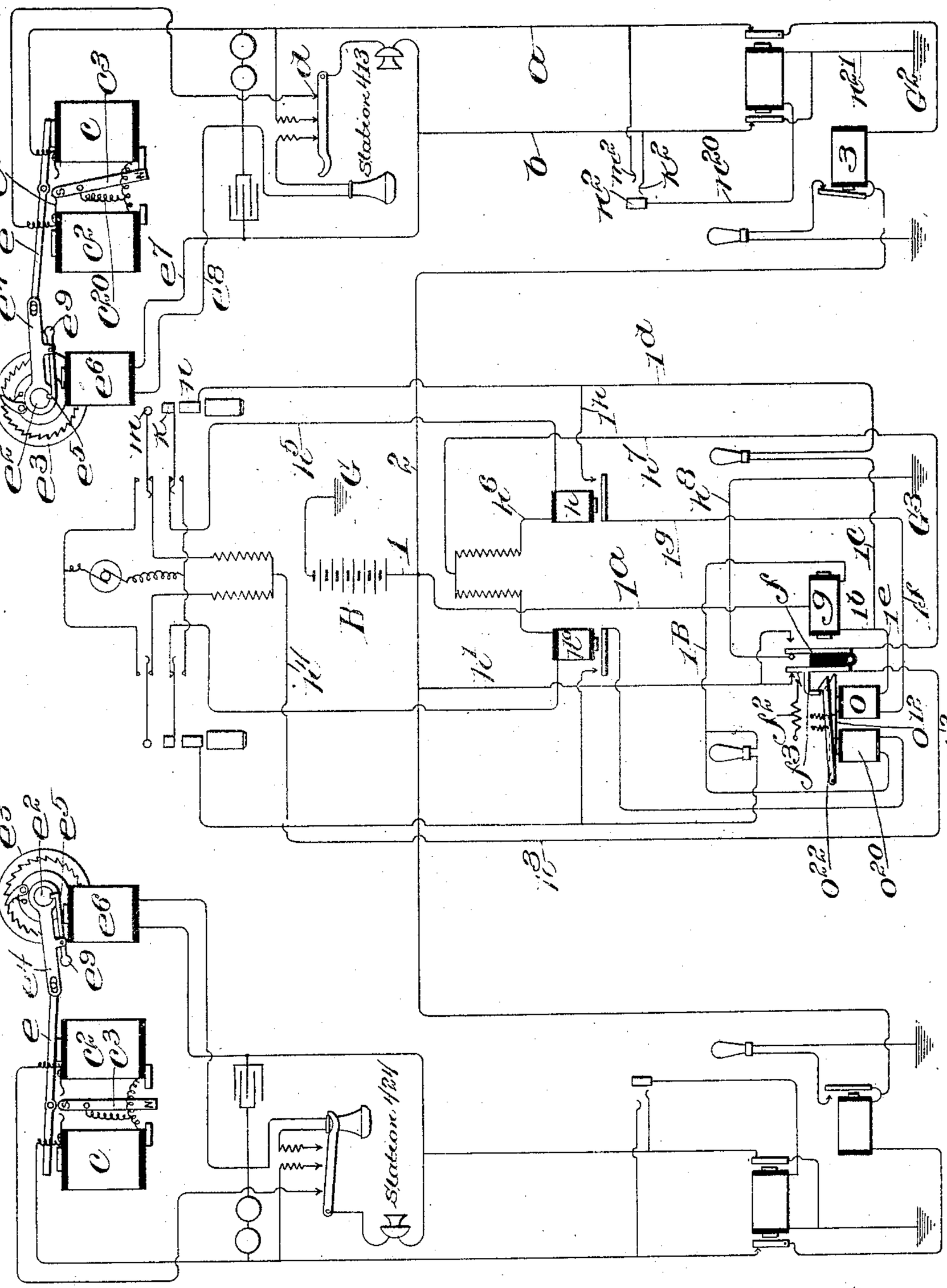

Witnesses:
Jas. J. Maloney.
Nancy P. Ford.

Inventor:
Newman H. Holland
by J. P. and W. J. Livermore
Attys.

UNITED STATES PATENT OFFICE.

NEWMAN H. HOLLAND, OF BROOKLINE, MASSACHUSETTS, ASSIGNOR TO CHARLES BATE, OF BOSTON, MASSACHUSETTS.

TELEPHONE-METER.

No. 896,830. Specification of Letters Patent. Patented Aug. 25, 1908.

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To all whom it may concern:

Be it known that I, NEWMAN H. HOLLAND, of Brookline, county of Norfolk, and State of Massachusetts, have invented an Improvement in Telephone-Meters, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The present invention relates to a telephone metering system in which a recording device or meter is arranged to record calls originating at each station.

The invention is embodied in means for controlling the recording mechanism so that calls will be recorded only after two lines have been actually connected for conversation; and also so that calls will be recorded only at the calling station, and not at the station called.

The invention is shown as embodied in the central energy or common battery system, and the meter is adapted to be operated by a current flowing over the line from the central office source, the operation of the meter belonging to any station depending, however, upon the consecutive action of currents differing in character, the closure of the telephone circuit at any station prior to the insertion of a plug in the jack belonging to said station causing a current of one character to flow through said station; while a device for changing the character of the current is adapted to be operated in response to the closure of the telephone circuits at both of two stations connected through the central office.

In the arrangement chosen to illustrate the invention, the closure of the telephone circuit at the station of the calling subscriber, which in the central energy system operates the signal at the central office, causes a flow of current to the calling station of the right character to set the recording mechanism belonging to the said station, (that is to say, causes the recording mechanism to be placed in condition to be operated); without, however, actually producing the operation of such recording mechanism; while the flow of current of a different character over the line to the said station to operate the meter is produced by connecting said station with the station of the called subscriber, and closing the circuit at the latter station.

The controlling device for altering the character of the current flowing over the line is herein shown as a pole changing switch located at the central office, the recording mechanism being arranged to be operated by currents flowing consecutively in opposite directions, the current in one direction placing the meter in condition to operate, while the current in the other direction produces the actual operation. The operation of the said pole changing switch is controlled by electro-magnets located respectively in the circuits of two stations which have been connected at central office, the arrangement being such that the pole changing switch cannot operate until both said electro-magnets have been energized, the energizing of each electro-magnet depending upon the closure of the telephone circuit at the station to which it belongs, so that the pole changing switch cannot operate until both stations are in condition for communication. These electro-magnets are shown as located in the circuits controlled by a pair of plugs at the central office, there being two of such magnets controlled by each pair of plugs, each magnet being in a separate circuit, one corresponding to each of two stations connected by said pair of plugs. The pole changing switch, therefore, will not operate to change the direction or character of the current until two stations have been connected and the telephone circuit at each station closed.

It is to be noted that the pole-changing switch, or equivalent device, is located in the answering branch of the cord circuit, while the means for finally controlling said pole-changing switch are located in the calling branch of the cord circuit, so that the operation of the meter depends finally upon the act of the called subscriber in taking down his receiver to answer.

The meter is herein shown as operated by an armature under the influence of an electro-magnetic system and arranged to remain in either of two positions, its movement in one direction producing no effect on the recording mechanism, while its movement in the other direction operates the said recording mechanism. After a call has been recorded, therefore, it is necessary to move the armature first in one direction and then in the other to record the next call, the two movements being produced by the consecutive currents of different character, as above described.

The drawing is a diagram showing two stations each provided with recording mechanism together with the connections between said stations and central office, and the circuits at central office controlled by one pair of plugs.

The control of the meter may be accomplished by any means capable of responding to consecutive currents of different character to first set and then operate the meter, but novel means for controlling the meter are herein shown and form part of the present invention. With the understanding, therefore, that the specific construction and arrangement of the meter controlling devices belonging to each station, while novel, are capable of modifications without changing the controlling devices at the central office, the central office construction, whereby the operation of the recording devices is controlled, will be taken up first, and the construction of the recording devices themselves described subsequently.

Upon taking down the receiver (as shown at station 413) the gravity hook closes the telephone circuit at the contact *d*, so that current flows from the battery B through the conductors 1 and 2 to the signaling magnet 3, and thence to the line *a* and through magnet coils *c*, c^2, and back through contact *d* to line *b*, which is connected with the other terminal of the battery. For convenience the battery is shown as grounded at G and the above connection made through the ground at G^2, although in practice a metallic circuit is commonly used. The same is true in regard to all the circuits, and it is to be understood therefore that the illustration is conventional. This completes a circuit through the instrument at station 413 and causes an impulse of current to flow over the line through the magnet coils *c* and c^2 and also through the signaling magnet 3 which is of usual arrangement so that the operator at central is called.

The magnet coils *c* and c^2 which coöperate with the armature *e* to operate the meter are provided with a supplemental armature c^3 which is polarized as indicated, so that when the current flows over the circuit above traced the said armature will be attracted by the magnet *c* as shown, and will shunt the magnet c^2 through a conductor c^{20} and contact c^{21}, thus causing the magnet *c* alone to act upon the armature *e* which is pivoted between the two magnets. The consequent movement of the armature *e* on its pivot to the position shown is transmitted through a crank e^4 to the operating shaft e^2 of the recording mechanism, the said operating shaft having a ratchet and pawl connection with one of the wheels e^3 of the recording mechanism, so that the movement of the armature above described does not produce any movement of the recording mechanism, but merely places the mechanism in condition to be moved or operated in response to a movement of the armature *e* in the opposite direction, to the position shown at station 424. Such movement is subsequently produced by an impulse of current flowing over the line in the opposite direction, which causes the armature c^3 to be moved towards the magnet c^2 so as to shunt the magnet *c* and to cause the magnet c^2 to operate alone upon the armature *e*, which results in the operation of the meter. The actual recording of a call, therefore, depends first upon the setting of the recording mechanism in condition to be operated, which is accomplished in response to the operation of signaling central, and secondly upon a change in the character of the current flowing over the line (such change being herein shown as a change in direction or polarity of the current), which is accomplished in response to the connection of two lines at the central office and the removal of the receiver at both the stations connected. As herein shown, the change in character of the current required to operate the meter depends upon the action of a pole changing switch *f*, located at central office and normally held as by a spring f^2 in the position shown, so that the current flowing over the line after the operator at central has plugged in upon being called, is in the same direction as that which flows over the line to energize the calling signal so that the plugging in will not cause the meter to operate. The said pole changing switch is under the influence of an electro-magnet *g*, the circuit through which is normally open but adapted to be closed when the plug is inserted in the jack. As herein shown, the ordinary supervisory circuit (of a so-called double supervisory system) is employed for this purpose. The said circuit (which is a local circuit at central office) may be traced as follows:—Battery B, conductor 1, conductor 1^a, magnet *g*, conductor 1^b (or 1^B according to which plug of the cord circuit is jacked), conductor 1^c, (which includes one of the supervisory signal lamps) conductor 1^d to plug terminal *n*, which, when the plug is inserted is in contact with jack terminal n^2, the latter being grounded or otherwise connected with the other terminal of the battery through conductors n^{20} and n^{21}. It is to be assumed that the plug belonging to station 413 is jacked, *i. e.* that station 413 has called central and that central has responded.

While the electro-magnet *g* is thus energized as soon as a plug is placed in any jack, it will not operate the pole changer *f* for the reason that the said pole changer is further controlled by circuits which depend upon the closing of the telephone circuits at two connected stations, said circuits containing respectively electro-magnets *h* and h^{10}, there being a circuit and a magnet included in each

set of circuits controlled by a pair of plugs, to correspond to each of the stations connected. These circuits and magnets present nothing novel in themselves, as they are the circuits and magnets now commonly employed to shunt the supervisory signal lamps. The closure of the telephone circuit at station 413, for example, and the insertion of a plug in the jack belonging thereto, will close the necessary circuit to energize the electro-magnet h belonging to said station, the said circuit being as follows;—Battery B, conductor 1, conductor h', switch f, conductor h^2, conductor h^3, conductor h^4, tip terminal m, jack terminal m^2, line a, line b (through the station, the receiver being down), jack terminal k^2, sleeve terminal k, conductor h^5, magnet h, conductor h^6, conductor h^7, switch f, conductor h^8, to the other side of the battery through ground G^3.

The circuit controlled by the armature of the magnet h is utilized in the present system to contribute in the control of the pole changer f, and for this purpose contains an electro-magnet o, the energizing of which depends of course upon the taking down of the receiver and the insertion of the plug, it being immaterial which is done first so long as both are done. This circuit may be traced as follows;—Battery B, conductor 1, conductor 1^a, conductor 1^b, conductor 1^e, electro-magnet o, conductor 1^f, conductor 1^g, conductor 1^h, conductor 1^d, to terminal n, which, as previously explained, is grounded when the plug is in, thus completing the circuit and energizing the electro-magnet o. This is the circuit commonly used for shunting and putting out the supervisory signal lamp, and by placing the magnet o in this circuit the purposes of the present invention may be accomplished without making any material change at the central office. The said electro-magnet o, located in the answering branch of the cord circuit, together with a companion electro-magnet o^{20} located in the calling branch of the cord circuit and energized upon the taking down of the receiver at the called station, coöperate with the pole-changing switch, or its equivalent, in such a manner as to cause the operation of said pole-changing switch after the telephone circuits are closed at both connected stations.

In the construction chosen for illustration, these electro-magnets coöperate with mechanical locking devices o^{12} and o^{22} which are indicated as latches coöperating with a stop or tail-piece f^3 so as to prevent the switch f from being shifted through the action of the magnet g so long as the tail f^3 is held by either latch. These latches are herein shown as pivotally supported in proximity respectively to the electro-magnets o and o^{20}, and held in engaging position by means of springs. The energization of the magnet o, however, will attract the latch o^{12} without affecting the latch o^{22} which, in turn, is capable of being attracted when the magnet o^{20} becomes energized. It is necessary, therefore, that two stations should be connected, and the receivers removed from the hooks at both stations, in order to produce the operation of the switch f and consequent operation of the calling subscriber's meter.

The operation of the system as thus far described may be briefly outlined as follows. Upon the closure of the telephone circuit at the calling subscriber's station the operator at central is notified in the usual way and inserts a plug in the jack of the calling line to establish communication with the calling station. The insertion of the plug energizes the electro-magnet g which remains energized as long as the plug remains in the jack. The telephone circuit being already closed at the calling station, the electro-magnet o which belongs to the said calling station will also be energized, thus operating one of the locking devices which control the pole changing switch. The operation of the pole changing switch, however, is still prevented by the other locking device, (in this case the latch o^{22}) which is controlled by the electro-magnet o^{20} which corresponds to the plug used in connecting the calling station with the station to be called. The insertion of the plug into the jack of the station to be called does not alone produce any further effect, but as soon as the subscriber at the station called closes his telephone circuit by taking down the receiver, the other locking device o^{22} is at once operated and the pole changing switch is operated owing to the influence of the electro-magnet g. It may be noted in this connection that substantially no new circuits are required at the central office in installing this system, it being practicable to place the electro-magnet g in one branch of the supervisory circuit and the electro-magnet o in the other.

The armature e of the meter is so arranged as to remain in either position until an impulse of current through one or the other of the electro-magnets c, c^2 causes it to change its position, it being obvious, therefore, that after a call has been registered there will be no further operation of the meter at that instrument until the mechanism is reset, so to speak, by taking down the receiver at said station. Consequently, the change in the character of current in response to the connection of two stations and the closure of the line circuit at said stations, although the current flows through the meter magnets at both stations, will not produce any effectual operation at the called station. It is possible, however, that the subscriber may set his meter by calling central office and if unsuccessful in obtaining connection, may leave his meter set, in which case a call would be recorded against it the next time he was connected with another subscriber who might

call for him. In order to guard against such accidental registration, the meter mechanism may be provided as shown with a device operating in response to incoming signaling currents for the purpose of rendering it impossible to operate the meter at the wrong station. A simple and effectual expedient for this purpose is shown, the crank e^4 which is adapted to be operated by the armature e being shown as provided with a catch e^5 by which it is connected with the shaft e^2 which operates the train of wheels. The said catch e^5 is under the influence of an electro-magnet e^6 which is included in a branch circuit e^7 e^8 in shunt with the bell-circuit, so that a ringing impulse coming in through the condenser will energize the said magnet e^6 causing a movement of the catch e^5. The said catch e^5 is shown as pivoted upon the crank e^4 and provided with a stop portion e^9 which engages with the said crank as soon as the stop has been moved far enough to become disengaged from the shaft e^2. The parts are so adjusted that the force of attraction will produce a further movement of the catch which will be transmitted to the crank, causing the same to turn and carry with it the armature e, the turning movement not being transmitted to the meter mechanism, because the catch has been disengaged. This will prevent any possibility of operation of the meter at the called station, while the parts will be restored to normal and the catch reëngaged the next time the meter is set in response to a call from this station.

It is not intended to limit the invention to the specific arrangement of circuits herein shown and described, nor to the specific construction, arrangement or location of the recording mechanism, since modifications may be made without departing from the invention.

Claims.

1. In a telephone metering system, a meter or recording device for each station; means for operating said meter in response to the consecutive action of currents differing in character; means for causing a current of one character to coöperate with the meter corresponding to one station in response to the closure of the telephone circuit at said station prior to the insertion of a plug in the jack belonging to said station; and a device for changing the character of the current operating in response to the closure of the telephone circuits at said station and another connected together at the central office.

2. In a telephone metering system, a central office and a number of stations, and a recording instrument for each station depending for its operation upon the consecutive action of currents differing in character; combined with means for causing a flow of current of one character in response to the closure of the telephone circuit at the station where the call is originated; and means for causing a flow of current of a different character in response to the closure of the telephone circuit at another station connected at said central office with the station first named.

3. In a telephone metering system, recording mechanism located at each station; means for setting the recording mechanism in response to current of one character; means for operating said recording mechanism in response to current of another character; means operating in response to the closure of the telephone circuit at a station where said telephone circuit is disconnected from the circuits controlled by the plug at central for causing current of one character to flow over the line to said station; and means operating in response to the closure of the telephone circuits of both of two stations connected together at central for causing current of another character to flow over the line to said stations.

4. In a telephone metering system, a central office and a number of stations, recording mechanism located at each station and controlled by an armature; an electro-magnetic system adapted to move said armature in a direction to operate said recording mechanism in response to current of a certain character only; means located at the central office for electrically connecting two stations; and means operating in response to the closure of the telephone circuits at both stations thus connected for causing a flow of current over the line of the right character to operate the meter.

5. In a telephone metering system, a central office and a number of stations, recording mechanism located at each station and controlled by an armature; an electro-magnetic system adapted to move said armature in a direction to operate said recording mechanism in response to current of a certain character only; means located at the central office for electrically connecting two stations; means operating in response to the closure of the telephone circuits at both stations thus connected for causing a flow of current over the line of the right character to operate the meter; and means located at the called station for preventing the operation of the meter at said station.

6. In a telephone metering system, recording mechanism located at each station; an armature for operating said recording mechanism; two electro-magnets adapted to act on said armature, one magnet being arranged to move it in one direction, and the other magnet in the other direction; a polarized armature also under the influence of said electro-magnets; contacts controlled by said polarized armature adapted to shunt one or the other of said coils according to the direction of movement of said armature; means

for closing a circuit through said coils in response to the closure of the telephone circuit at the station where they are located; means for connecting the telephone at the said station with a telephone at another station; and means for changing the direction of the current in response to the closure of the telephone circuit at the latter station.

7. In a telephone metering system, the combination with a meter belonging to each station; of means for setting the said meter in condition to operate in response to current flowing in one direction from a source of current at central office; means for closing a circuit from said source through said meter in response to the closure of the telephone circuit at the station to which the meter belongs; a pole changing switch; and means for operating said pole changing switch to change the direction of the current, said means comprising electro-magnets energized by circuits closed by connecting two stations and by closing the telephone circuits at said connected stations, as set forth.

8. The combination with a meter for each instrument; of a device located at the central office for controlling the operation of said meter; an electro-magnet to operate said device; means located at the central office for closing a circuit through said electro-magnet; means for preventing the operation of said device; two electro-magnets jointly controlling said means; and means located at two connected stations for closing circuits through said electro-magnets, respectively.

9. The combination with a meter to record calls at a sub-station; of an armature adapted by its movement in one direction to place said meter in condition to operate and by its movement in the other direction to cause said meter to operate; and means for disconnecting said armature from said meter in response to an incoming signaling impulse at the station the calls from which are to be recorded by the meter.

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

NEWMAN H. HOLLAND.

Witnesses:
HENRY J. LIVERMORE,
JAS. J. MALONEY.