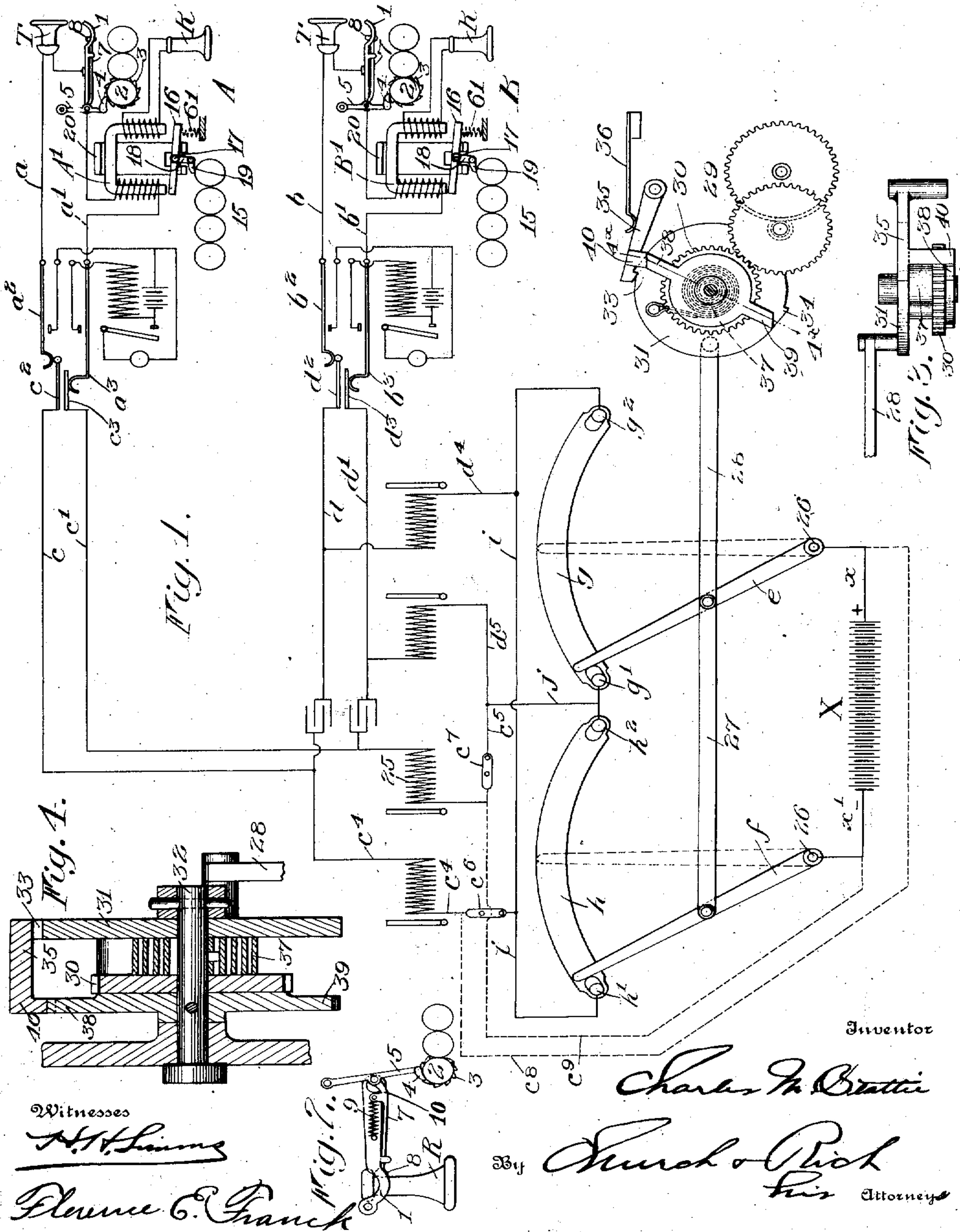


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 SYSTEM FOR METERING SERVICE ON THE LINES OF TELEPHONE EXCHANGES.
 APPLICATION FILED SEPT. 9, 1907.

912,268.

Patented Feb. 9, 1909.



Witnesses
W. H. Lums
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Fig. 2.
Fig. 3.

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UNITED STATES PATENT OFFICE.

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SYSTEM FOR METERING SERVICE ON THE LINES OF TELEPHONE-EXCHANGES.

No. 912,268.

Specification of Letters Patent.

Patented Feb. 9, 1909.

Application filed September 9, 1907. Serial No. 391,874.

To all whom it may concern:

Be it known that I, CHARLES M. BEATTIE, of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Systems for Metering Service on the Lines of Telephone-Exchanges, and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of the specification, and to the reference characters marked thereon.

My present invention relates to telephony and it has for its object to provide an arrangement of apparatus for automatically recording the length of time a subscriber's telephone instrument circuit is busy, or in use, either in receiving or despatching messages, or the aggregate time consumed in despatching or receiving all messages occurring during a given period; said apparatus comprising generally a meter or recording device which is actuated when a telephone circuit is closed to show the number of calls, and a separate meter for recording the length of time said line is in use.

The invention has for its further object to provide a meter or recording device associated with a subscriber's telephone instrument circuit which is operated in conjunction with apparatus located at the central office or exchange, which is designed to actuate the meter at regular intervals of time while the instrument circuit is connected for talking purposes with another circuit.

To these and other ends the invention consists in certain improvements and combinations of parts all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings: Figure 1 is a diagrammatic view showing two telephone instrument circuits provided with mechanism embodying my invention and the central office apparatus associated with said circuits. Fig. 2 is an enlarged side elevation partly in section of the metering device employed for registering a number of calls, initiated on a telephone circuit. Fig. 3 is a detail plan view of the time controlling mechanism; and Fig. 4 is an enlarged sectional view taken on the line 4^x—4^x of Fig. 1.

Similar reference characters in the several figures indicate similar parts.

In illustrating my invention, I have shown diagrammatically in Fig. 1 two subscribers' telephone instrument circuits indicated generally by A and B, each of which comprise the usual transmitters T, and receivers R, arranged in circuits comprising the line wires *a*, *a'*, *b*, and *b'* respectively. At the central office, or exchange, these conductors lead to the usual switchboard jacks comprising the tip contact springs *a*² and *b*² and the sleeve contact springs *a*³ and *b*³ with which cooperate the plugs of the answering and calling cord circuits indicated in the present instance by *c*, *c'* and *d*, *d'* terminating in the tip contacts *c*², *d*² and the sleeve contacts *c*³, *d*³. Both of the recording or metering devices are arranged at the subscriber's station, and one of them is adapted to be actuated manually by the subscriber when he closes his instrument circuit, and the other device is adapted to be actuated automatically when a desired connection at the central office has been established between said subscriber's circuit and that of another subscriber, by means of the central office mechanism which will be more fully explained hereinafter. This meter records the length of time either the calling or called instrument circuit, or both of these circuits, are in use in given units of time, which may be either minutes or seconds of an arbitrary selection.

The meter for recording the number of calls is preferably arranged to be operated in conjunction with the usual receiver hook 1 of the telephone apparatus, and comprises a recording mechanism 2, of the usual or any preferred construction, embodying revoluble numeral disks of the units, tens, hundreds, and thousands order, the first of which is adapted to be advanced progressively each time the receiver R is removed and replaced. To this end said wheel may be provided with ratchet teeth 3 with which cooperates a pawl 4 carried on an oscillatory arm 5. As it frequently happens that a subscriber may be compelled to open his circuit in order to attract the attention of the exchange operator, especially if his instrument circuit is one of a so-called central energy system, such as is illustrated in the diagrammatic view, and to do so it is necessary for him to operate his receiver hook two or more times; therefore in order to obviate recording false calls the operating mechanism is

adapted to be controlled by the receiver when it is placed on the hook. This object may be accomplished in different ways and as one embodiment of the invention I have shown a controlling member 7 which is guided to move longitudinally on the receiver hook 1 and has its forward end 8 located between the sides of the fork at the outer end of the hook arm, and normally projected by a spring 9 in such a position that the member 7 is moved inwardly and retained by the receiver R when it is restored to its normal position on the hook. The rear end 10 of the member is pivotally connected to the arm 5 and serves to oscillate it in one direction to actuate the counter mechanism, when the subscriber removes his receiver, and to restore said arm to its normal position when the receiver is replaced on the hook, as will be understood. The other registering mechanism employed for recording the length of time the telephone is in use is indicated by 15. The mechanical features thereof may be similar to the meter already described, although the means for operating it comprises electro magnetic devices associated with the instrument circuit and adapted to be actuated by current thereon at given intervals of time by devices located at the central office. The means which I have shown for operating this meter comprises in part the inductive windings in the telephone instrument circuits, which are arranged upon the pole pieces of magnets A' and B', one of each of said pole pieces being in the main circuits, while the other supports the secondary circuits of the receivers, as illustrated in Fig. 1, so that when the subscribers' instrument circuits are closed, by the closing of the receiver hooks and current is supplied thereto, said magnets will become active. Cooperating with each of these magnets is an armature 16 supported on a central pivot 17 and connected by an arm 18 to a pawl 19 cooperating with the units wheel of the meter 15, whereby the latter may be advanced one step for each oscillation of the armature. The latter is polarized so that its two extremities are poles of the same sign, which object may be conveniently obtained by the use of a permanent magnet 20 having its extremities arranged in proximity to the operating magnet, A' or B', and the armature 16 cooperating therewith.

The apparatus located at the central office or exchange employed for actuating the time recording meter comprises mechanism for varying the potential of the current supplied to the subscriber's instrument circuit at given intervals of time to alternately deenergize and energize the electro magnets. In order not to interrupt the undulatory voice currents which may be traversing said line and to prevent a disagreeable click or vibration

in the diaphragm of the subscriber's closed circuit, this apparatus is arranged to gradually decrease the potential of said current and to subsequently increase it gradually to the maximum voltage. One form of apparatus which I have shown for carrying out this embodiment of my invention comprises rheostatic devices interposed in the path of the current supply embodying a uniform resistance, bridged across the line conductors, and a movable contact arm which is adapted to traverse said resistance and to supply current thereto. The same form of apparatus is adaptable to systems in which local battery is used for supplying current for talking purposes, or to central energy systems in which the source of current is located at the central office. The last mentioned system is, however, the most desirable and the one illustrated in the diagrammatic view in which the main battery or the source of the current supply is indicated by X, the positive and negative terminals thereof indicated by x and x' being connected respectively to the contact arms e and f , the extremities of which sweep over the resistances g and h , respectively. These may consist of shallow beds of graphite or be otherwise constructed so that the current flowing through them may be gradually diminished uniformly as the arms are moved relatively away from the terminals at one end, and likewise increase uniformly as said arms are returned or moved toward their opposite extremities. These resistances are bridged in multiple across both the answering and calling cord circuits, when it is desired that a record shall be obtained of the time an instrument circuit is in use whether or not such use is at the instance of the subscriber initiating or answering calls. However, if it is desired to record only one class of calls the central office apparatus may be associated only with one of the cord circuits as for instance, that of the answering cord, in which event a record of the time an instrument circuit is in use will be obtained only when calls originated therefrom.

When the central office apparatus is bridged to both cord circuits the connections will be as follows: The terminals at right and left hand ends of the resistances g and h respectively are joined by a conductor i from which lead taps e^1 and d^1 to the cord conductors c and d . The terminals at the other extremity of the resistances g and h are connected by a conductor j which is likewise connected by taps e^2 and d^2 with the cord conductors c' and d' , said taps being provided with the usual relay impedance coils 25 representing the operator's supervisory means as will be understood. The movable parts or arms of the rheostatic devices are pivoted as at 26 and are connected for simultaneous movement by a connecting rod 27, one end of which may be extended to form a

pitman 28 connected to the timing devices which are adapted to oscillate the contact arms *e* and *f* at regular intervals of time. The timing devices may be of any desired construction and in the present instance I have shown them as comprising a clock work train 29, one gear wheel 30 thereof being the controlling member which is rotated at a given speed and governs the movement of the arms *e* and *f* through intermediate mechanism. The latter comprises a disk 31 journaled on a shaft 32 and provided at diametrically disposed points with teeth 33 and 34 with which coöperates a pivoted pawl 35 which is operated by the spring 36. The disk 31 is loosely journaled on the shaft 32 and connected thereto at one end is a spring 37, the inner end of which is coiled about the shaft and is secured thereto as is also the gear wheel 30, whereby as the latter is rotated a tension is imparted to said spring which will rotate the disk 31 when the detainer pawl 35 is released. Also attached to the shaft 32 are the release arms or strips 38 and 39 having beveled cam surfaces which are designed to engage a similar surface on a lateral projection 40 on the pawl 35 to cause the latter to be disengaged from one of the notches on the disk 31 at each partial rotation of the shaft 32. By this arrangement of the parts, it will be seen that the rotation of the disk is prevented for a predetermined length of time when the contact arms *e* and *f* are in engagement with the terminals at either extremity of the resistances *g* and *h*, and that as the shaft 32 continues to be revolved by the movement imparted to the gear wheel 30 by the clock train, the spring 37 is placed under tension, its force to be exerted to oscillate the arms *e* and *f* when the detent is disengaged from one of the notches 33 or 34.

The reversal of the arms *g* and *f* may occur regularly at any predetermined interval of time, and in practice it is found that periods of about twenty seconds each are satisfactory and that computations on this basis may be easily made from the records appearing on the meter 15, which is actuated upon each reversal in the direction of the flow of current which occurs upon the shifting of the arms *e* and *f* as will be seen by tracing the following circuit: battery X, wire *x'*, contact arm *f*, terminal *h'*, wire *i* and thence by the taps *c'* and *d'* to the calling and answering subscribers' instrument circuits, by means of which the magnets A' and B' are energized and will effect a movement of their respective armatures 16 in one direction; the current returning thence to the battery over the taps *c*, *d*, wire *j*, terminal *g'* arm *e*, wire *x*, to battery X. Now when the disk 31 is rotated a half revolution, the arms *e* and *f* will contact with the terminals *g* and *h* respectively, and the current flowing in the opposite di-

rection over the aforescribed circuits will change the polarity of magnets A' and B' causing their armatures to rock in the opposite direction and impart movement to their respective recording devices. It will be seen then, that since the resistances *g* and *h* are uniform, the potential of the current of the battery is decreased as the arms *e* and *f* move away from terminals at one end and that as they approach a neutral point between said terminals and those at the other extremities of the resistances, that the battery is in effect short-circuited, but that owing to the fact that said resistances are relatively high, the loss of current, if any, at such time will be small, and will be of momentary duration only because of the rapid movement imparted to said arms. It will be noted that as the current is gradually reduced, it is also gradually increased in strength after the arms *e* and *f* have passed the neutral point and are approaching the terminals at the other extremity of said resistances, so that the telephone instrument circuits are free of disturbances which might be caused by the sudden application or removal of the current. By reason of the rapid movement of the arms *e* and *f* they pass the neutral points of the resistances so quickly that the cessation of current to the transmitters is of such short duration that no inconvenience is experienced by the subscriber who may be conversing at the very instant this shifting of the arms takes place. During the movement of the arms current sufficient for talking purposes is supplied in decreasing quantities until such time as the arms almost reach the neutral points of their resistances; and they commence to again apply the current as soon as the arms have passed said points.

In Fig. 1 two switch arms *c*⁶ and *c*⁷ have been shown arranged in the taps *c*⁴ and *c*⁵. When those switch arms are closed as shown in that figure the variation of the talking current by means of the rheostatic device is effective on both sides of the cord circuit and will actuate the recording device at the station of the calling subscriber and also at the station of the called subscriber. Should it, however, be desired to actuate the meter only at the calling station, then the switches *c*⁶ and *c*⁷ are opened and the taps *c*⁴ and *c*⁵ on the side of the cord circuit in which the calling plug is included are connected by wires *c*⁸ and *c*⁹ with the wires *x* and *x'* respectively, as indicated in dotted lines. In that case the side of the cord circuit in which the answering plug is included, is the only side affected by the variations due to the operation of the rheostatic device and the recording device of the calling subscriber only will be actuated. If it is desired to actuate only the recording device of the called subscriber, as when a charge is to be reversed,

then the answering plug of the cord circuit is inserted in the spring jack of the called subscriber and the calling plug in the spring jack of the calling subscriber, as will be readily understood.

My description of the apparatus employed has been thus far confined to effecting the operation of the time recording meters by a reversal of the current, but this may be effected by merely a reduction of the potential of the current without reversing its direction of flow, but in such a case the armatures 16 of the magnets A' and B' must be operated in one direction mechanically by means of springs 61 (shown in dotted lines) or equivalent devices, provided for retracting the armatures into inoperative position. The current applied in this manner is impressed upon the circuit so that it is merely necessary to operate the contact arms e and f to the neutral point of the resistances g and h, as shown in dotted lines in Fig. 1, and then restore them to the position shown in full lines in said figure, as this movement is all that is required to gradually decrease the flow of current and subsequently gradually increase it. The crank disk 31 in such case would be designed to make a complete revolution at each operation.

The apparatus I have described and illustrated permits a complete record to be had of telephonic service rendered for each instrument circuit, both as to the number of calls despatched and received and the aggregate length of time which a telephone circuit is in use between given periods. The manually operating meter recording, as it does, the number of connections set up by the operator at the central office gives the basis on which a flat rate or rental may be based in payment for the labor in setting up the connections, and the time service meter, from which the number of minutes or fractions thereof may be obtained, gives a basis for a charge of a different character based upon the length of time a line is in use. As the operating expenses of telephone systems fall within these two classes, an accurate charge based upon metered service should be proportioned between these different classes of expenses.

I claim as my invention:

1. In a telephone metering system, the combination with a subscriber's instrument circuit, a source of current supply for talking and supervisory purposes and means for reversing the direction of the flow of said current, of a registering device associated with said circuit comprising an electromagnetic operating mechanism adapted to be actuated upon each change in the direction of flow of said current.

2. In a telephone metering system, the combination with a subscriber's instrument circuit, a source of current supply for talking

and supervisory purposes, and means for alternating the direction of the flow of said current at uniform intervals of time, of a registering device associated with said circuit for recording the number of current reversals, and electromagnetic devices for operating said device adapted to be actuated by said current reversals.

3. In a telephone metering system, the combination with a subscriber's instrument circuit, a registering device associated therewith and a source of current supply for talking and supervisory purposes, of means interposed between said source and the instrument circuit for alternately reversing the connections between the two sides of the circuit and said source and electromagnetic devices operated upon each of said alternations to actuate the registering device.

4. In a telephone registering system, the combination with two subscribers' instrument circuits, central office calling and answering cord circuits for connecting them, and a source of current connected to said cord circuits for supplying both instrument circuits with current for talking and supervisory purposes, of recording devices associated with each instrument circuit, means for alternately reversing the direction of the flow of current over the instrument circuits and electromagnetic mechanisms actuated by each current reversal for actuating the recording devices.

5. In a telephone registering system, the combination with a normally open circuit, a subscriber's telephone set arranged in the circuit and a device for recording time intervals; mechanism for operating it comprising a magnet associated with the instrument set which is adapted to be energized when the circuit is closed and the instrument set is in operation and a polarized armature for said magnet, of a source of current supply for operating the instrument set in said circuit and means for reversing the direction of flow of the current therein periodically to cause a corresponding operation of the recording device while the telephone set is in use.

6. In a telephone registering system, the combination with a normally open circuit, a subscriber's telephone instrument set arranged therein, a recording device, mechanism for operating it comprising a magnet arranged in the instrument set which is placed in the circuit when the instrument set is in use, and a polarized armature for said magnet, of a source supplying direct current for operating the instrument set in said circuit, means for changing the polarity of said magnet and timing devices for controlling said changes at regular intervals.

7. The combination with a telephone instrument circuit, and a source of current supply for talking purposes, of means for reversing the direction of flow of said current over

said circuit embodying a rheostatic device comprising a resistance connected to the two sides of the circuit and a movable part adapted to travel over the resistance to gradually
 5 reduce the amount of current flowing to one side of the circuit and gradually increase the amount thereof flowing to the other side of the circuit, means for moving said part and metering devices adapted to be operated by
 10 said current in said circuit.

8. The combination with a telephone instrument circuit and a relatively high resistance bridged across the circuit, of a source of current supply, a contact arm connected
 15 thereto and feeding current to said resistance, means for adjusting the arm thereover at regular intervals of time, said resistance being arranged to reduce the flow of current to one side of the circuit and increase the flow
 20 of such current to the other side thereof during the movement of the arm, and devices adapted to be operated by current in said circuit at corresponding intervals to give a time record.

9. The combination with a telephone instrument circuit comprising two conductors and two resistances each bridging the conductors, of a contact arm cooperating with
 25 each resistance, a source of current supply bridged to the two arms, means for causing the latter to traverse their respective resistances at regular intervals of time and means associated with said instrument circuit which
 30 is adapted to be operated by changes in the potential of current thereon to give a time record corresponding to the movements of the arms.

10. The combination with a telephone instrument circuit and a source of current supply for talking and supervising purposes, of
 40 means for varying the potential of such current, and registering mechanism comprising electromagnetic devices arranged in said circuit and adapted to be actuated upon each
 45 change of said current.

11. In a system for metering telephone service, the combination with a normally open circuit, a telephone set comprising a transmitter, a receiver and a receiver hook
 50 controlling contacts for closing said circuit when the set is in use and a recording device comprising an electromagnetic operating mechanism which is included in the circuit when the hook contacts are closed, of a
 55 source of current supply for operating the instrument set and means for effecting the operation of said electromagnetic mechanism by gradually reducing and subsequently increasing the potential of the current on said
 60 circuit.

12. The combination with a telephone instrument circuit central office apparatus comprising a cord circuit and a source of current supply, of rheostatic devices comprising
 65 resistances bridged in multiple across said

cord circuit, contact arms connected to opposite terminals of the source of current supply and feeding current to said circuit through the resistances, means for simultaneously
 70 moving said arms over the latter at regular intervals of time, and electromagnetic recording devices adapted to be actuated by variations of the current supplied through said resistances at corresponding intervals to
 75 give a time record.

13. The combination with an instrument circuit, and an inductive type telephone set thereon comprising primary and secondary windings, pole pieces arranged in said windings, and an armature actuated thereby, of a
 80 service recording meter associated with the instrument set and operated by the armature.

14. The combination with a normally open line circuit, a telephone set arranged therein
 85 comprising a receiver having the usual diaphragm, and contacts controlled by the receiver for closing said circuit, of a service meter, an electromagnetic device associated with the telephone set and included in the
 90 line circuit when the latter is closed to operate the meter, a source of current supply for talking purposes and rheostatic devices for controlling its potential by reducing and subsequently increasing the flow of current
 95 by graduations which do not affect the diaphragm of the receiver.

15. In a telephone system, the combination with a plurality of subscribers' instrument circuits and a central office equipment
 100 comprising operators' cord circuits for connecting two or more subscribers' circuits, embodying means for supervising said connections and a source supplying current for talking purposes to the instrument circuits
 105 and the cord circuits for operating the supervising means, of a telephone set comprising an induction winding which is arranged in series in each subscriber's circuit for telephonic purposes when the latter is in use, a
 110 service recording meter associated with each telephone set and actuated by the current supplied to said winding.

16. In a telephone system, the combination with a plurality of subscribers' instrument
 115 circuits and a central office equipment comprising operators' cord circuits for connecting two or more subscribers' circuits embodying means for supervising said connections and a source supplying current for
 120 talking purposes to the instrument circuits and the cord circuits for operating the supervising means, of means for varying the potential of said current, a telephone set comprising a winding which is brought into
 125 each subscriber's instrument circuit when the latter is in use and a service recording meter controlled by current supplied to said winding and actuated by current therein upon each variation of said current.
 130

17. In a telephone system, the combination with a plurality of subscribers' instrument circuits and a central office equipment comprising operators' cord circuits for connecting two or more subscribers' circuits embodying means for supervising said connections and a source supplying current for talking purposes to the instrument circuits and the cord circuits for operating the supervising means, of time controlled mechanism located at the central office for periodically varying the potential of said current, a telephone set in each subscriber's circuit embodying a winding which is brought into the circuit when the latter is in use and a service recording meter actuated by current in the

winding upon the successive variations of potential in the current flowing through said winding.

18. The combination with a telephone circuit carrying the ordinary talking current, of a current controller for gradually reducing and restoring the talking current, an actuator for operating said controller periodically, and a recording device actuated by such periodic changes of the talking current during the use of the telephone.

CHARLES M. BEATTIE.

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RUSSELL B. GRIFFITH,
FLORENCE E. FRANCK.

Corrections in Letters Patent No. 912,268.

It is hereby certified that in Letters Patent No. 912,268, granted February 9, 1909, upon the application of Charles M. Beattie, of Rochester, New York, for an improvement in "Systems for Metering Service on the Lines of Telephone-Exchanges," errors appear in the printed specification requiring correction, as follows: In line 118, page 2, the reference character " d^5 " should read d^4 , and in line 118, page 3, the reference character " c^3 " should read c^1 ; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 16th day of March, A. D., 1909.

[SEAL.]

C. C. BILLINGS,
Acting Commissioner of Patents.

17. In a telephone system, the combination with a plurality of subscribers' instrument circuits and a central office equipment comprising operators' cord circuits for connecting two or more subscribers' circuits embodying means for supervising said connections and a source supplying current for talking purposes to the instrument circuits and the cord circuits for operating the supervising means, of time controlled mechanism located at the central office for periodically varying the potential of said current, a telephone set in each subscriber's circuit embodying a winding which is brought into the circuit when the latter is in use and a service recording meter actuated by current in the

winding upon the successive variations of potential in the current flowing through said winding.

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