

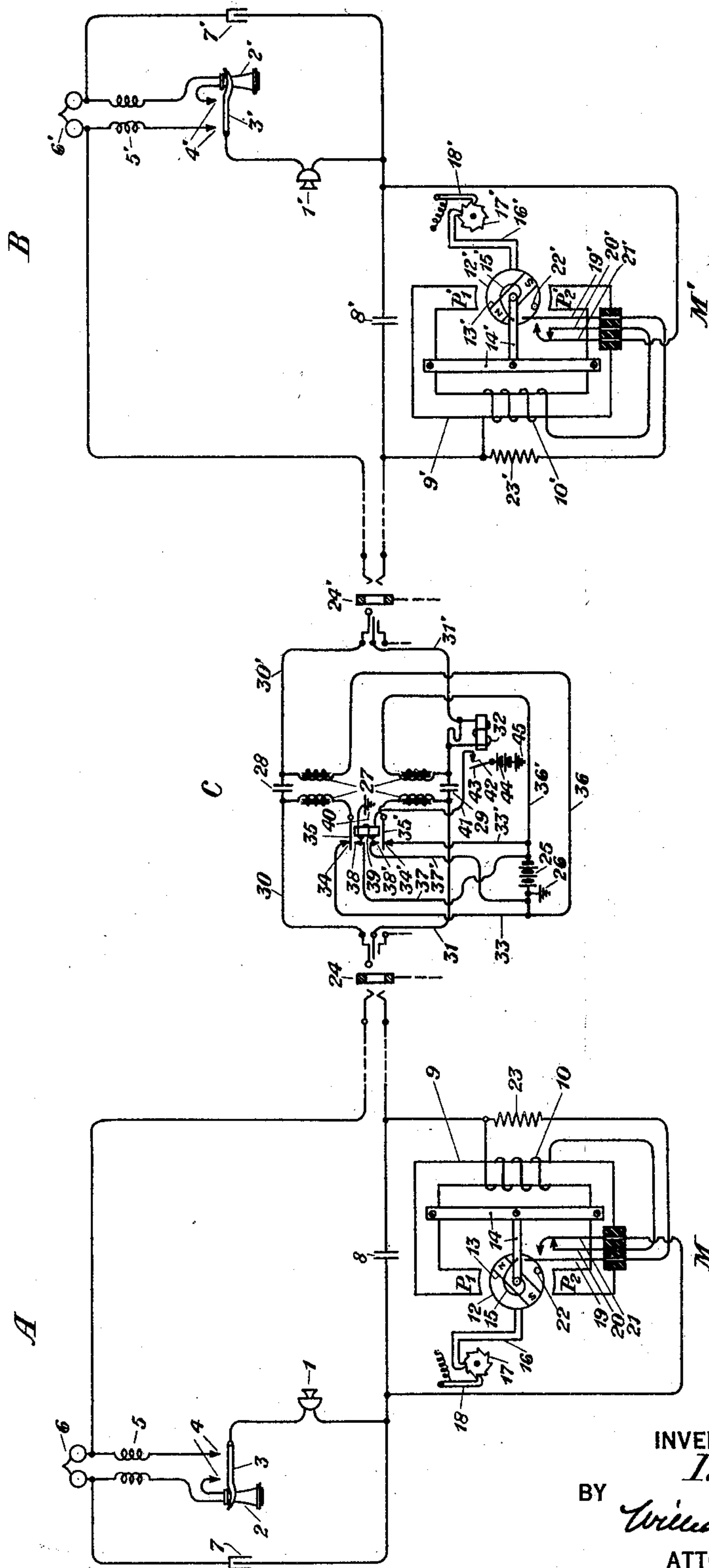
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and more particularly to a telephone system which includes a measuring device located at the subscriber's station which is adapted to be operated by a constant direct current in the line to measure the length of time the telephone is in use.

In the telephone metering systems heretofore proposed, in which a meter was located at the subscriber's station, it was found necessary in order that the meter be operated at predetermined intervals of time to vary the line current periodically during the conversation. It is obvious that any artificial or abnormal variation of the line current will introduce objectionable disturbances in the talking circuit. Consequently, expensive apparatus had to be installed in order to eliminate these disturbing effects.

It is an object of this invention to provide a telephone metering system which includes a meter located at the subscriber's station and capable of being operated automatically at definite intervals of time by the normal direct current present in the line.

A better understanding of the invention may be had from the detailed description hereinafter following.

The drawing represents diagrammatically a telephone system illustrating one embodiment of the invention.

In the drawing two subscribers' stations A and B are shown with subscribers' loops extending to the central office and terminating in the jacks 24 and 24'. As shown A represents the station of the calling subscriber and B that of the called subscriber. Substation A comprises the usual transmitter 1, the receiver 2, the receiver hook 3, contacts 4, induction coil 5, ringer 6 and capacity 7. In addition, there is located at the substation a meter M connected in series with the substation circuit with a by-pass condenser 8 provided to permit the voice signals to pass therethrough rather than through the meter winding.

The meter M, as shown, includes an electromagnet 9, the core of which is laminated, having a winding 10 and poles P_1 and P_2 . A pivoted balance wheel 12 of non-magnetic

material, having embedded therein a permanent magnet 13, is positioned between said poles and supported by the non-magnetic bar members 14. A coil spring 15 is provided to maintain said balance wheel in the normally biased position shown. When the polarity of the pole P_1 changes from north to south and that of the pole P_2 changes from south to north, the balance wheel is adapted to oscillate back and forth under the influence of the magnetic field and of the coil spring 15. The movement of said wheel causes the pawl 16, through suitable gearing mechanism not shown, to operate the ratchet wheel 17. A holding pawl 18 is provided to hold said ratchet wheel in its operated position. A make-before-break switch including the contact springs 19, 20 and 21 is positioned in such a manner that, as the balance wheel oscillates, the bar member 22, located thereon, will come in contact with the spring 19 and cause it to make contact with the spring 21 and then break the normally existing contact between the springs 20 and 21. The establishment of the contact between the springs 19 and 21 connects the resistance 23 in parallel with the winding 10 of the electromagnet and the breaking of the contact between the springs 20 and 21 disconnects the winding 10 from the circuit. The resistance 23 is substantially the same in value as that of the winding 10, the resistance of each being as low as practicable.

The arrangement at substation B is the same as that shown at substation A, as described above.

The cord circuit C of the central office is here illustrated as the impedance coil feed type. Obviously, a cord circuit of the repeating coil feed type may be used, if desired. The cord circuit shown comprises the usual current source 25, grounded at 26, a current supply bridge comprising impedance coils 27, capacities 28 and 29, cord conductors 30, 30', 31 and 31' and the supervisory relay 32. The current is normally supplied to the calling line through the leads 33 and 33', the contacts 34 and 34', the armatures 35 and 35', the left-hand impedance coils 27 and the cord conductors 30 and 31, and to the called line

through the leads 36 and 36', the right-hand impedance coils 27 and the cord conductors 30' and 31'. In addition, a switching means under the control of the relay 32 is provided to reverse the polarity of the current in the calling line through the leads 37 and 37' and the contacts 38 and 38'. This switching means includes a relay 39, grounded at 40, the lead 41, the contact 42, the armature 43 and the battery 44 grounded at 45.

The operation of the system is as follows: When the calling subscriber at station A removes his receiver from the hook to initiate a call, the operator in response to the signal establishes a connection to the central office through the jack 24 in the well known manner. At this time, the current flows from the positive terminal of the source 25, through the lead 33, the contact 34, the armature 35, upper left impedance coil 27, the cord conductor 30, the jack 24, the induction coil 5, the contact 4, the receiver hook 3, the transmitter 1, the spring 21, the spring 20, the winding 10, back through the jack 24, the cord conductor 31, the lower left impedance coil 27, the armature 35', the contact 34' and the lead 33' to the negative terminal of the source 25. With this direction of current flow through the winding 10, the pole P_1 becomes a north pole and P_2 a south pole. The magnet 15 is repulsed and the balance wheel 12 remains in its normal, biased position, as shown, and hence no registration occurs. The operator completes the connection to the called subscriber B through the jack 24' and transmits the ringing current over the latter line. This ringing current does not operate the meter located at the station of the called subscriber B because the meter is made sufficiently sluggish in operation to prevent its response to the rapid variation of the ringing current. When the called subscriber removes his receiver from the hook, the circuit including the relay 32 is closed in the well known manner. The closure of this circuit and the resulting energization of the relay 32 cause relay 39 to be energized by the closure of the connection between the contact 42 and the armature 43. When it is energized, the relay 39 attracts its armatures 35 and 35' to break their connection with the contacts 34 and 34', respectively, and to establish their connection with the contacts 38 and 38', respectively. This reverses the polarity of current in the calling line, said current now flowing from the positive terminal of the source 25, through the lead 37', the contact 38', the armature 35', the lower left impedance coil 27, the cord conductor 31, the jack 24, the winding 10, the spring 20, the spring 21, the transmitter 1, the receiver hook 3, the contact 4, the induction coil 5, back through the jack 24, the cord conductor 30, the upper left impedance coil 27, the armature 35, the contact 38 and the lead 37 to the negative ter-

minal of the source 25. With this direction of current flow through the winding 10, the pole P_1 becomes a south pole and P_2 a north pole. The north pole of the magnet 13 is attracted toward the pole P_1 and the south pole of the magnet 13 is attracted toward the pole P_2 , which causes the balance wheel 12 to rotate, as shown, in a counter-clockwise direction in opposition to the force exerted by the coil spring 15. This rotation causes the pawl 16 to advance the ratchet wheel 17 one step. As the balance wheel 12 rotates in this direction, the bar member 22 comes in contact with the spring 19 and first causes it to make contact with the spring 21 which connects the resistance 23 in parallel with the winding 10 and then causes it to break the normally existing contact between springs 20 and 21 which disconnects the winding 10 from the circuit. The connection of the resistance 23 in the circuit immediately before and during the time when the winding 10 is connected substantially prevents the line from becoming unbalanced with attendant disturbances in the talking circuit. When the winding 10 is disconnected, the pole P_1 and P_2 are demagnetized and the balance wheel 12 rotates back to its normal, biased position under the influence of the force exerted by the coil spring 15 and the springs 19 and 21. As the balance wheel rotates back, the force exerted by the bar member 22 on the spring 19 is removed which, first, permits the contact between the springs 20 and 21 to be reestablished, which reconnects the winding 10 in the circuit, and, then, permits the contact between the springs 19 and 21 to be broken, which disconnects the resistance 23 from the circuit. The poles P_1 and P_2 are again magnetized as before and the cycle is repeated as long as the connection between the subscribers remains closed. As the balance wheel rotates in the direction to operate the ratchet wheel, its momentum causes it to rotate to a position in which the magnet 15 is an appreciable distance beyond the poles P_1 and P_2 . When the force exerted by the coil spring 15 and the springs 19 and 21 overcomes the momentum, the balance wheel rotates back toward its normal position. Again, its momentum causes it to rotate to a position in which the magnet 15 is a substantial distance beyond its normal position. When the magnetic attraction of the poles P_1 and P_2 overcomes the momentum, the balance wheel rotates again in the direction to operate the ratchet wheel. Thus, a definite time interval is created between registrations, depending upon the strength of the magnetic field, the momentum of the balance wheel and the force exerted by coil spring 15 and the springs 19 and 21.

In order to prevent false registration due to ringing current and to the flashing of the receiver hook, the mass of the balance wheel

is so selected that the moment of inertia thereof will be sufficient to provide sluggishness of action.

As shown and described, the current reversing means is connected on one side of the cord circuit only since, in general, it is desirable to charge the call to the calling subscriber only. It is obvious, however, that such means may be applied to other types of charging systems, for example to a system in which it is desirable to charge the call to the called subscriber only or to a system in which it is desirable to charge the call to both the calling and the called subscribers. Likewise, the association of said reversing means with the cord circuit may be under control of other means than the relay 32 and in such a manner that the operation of the meter will begin at any desired time during the connection.

While this invention has been illustrated in connection with a typical cord circuit using manual operation, it is apparent that it is equally applicable to machine switching apparatus.

What is claimed is:

1. In combination, an electromagnet connected in series with the calling line of a telephone system, a pivoted armature adapted to move back and forth under the influence of said magnet and having a predetermined frequency of vibration, means for registering the number of times said armature vibrates, a resistance of substantially the same value as that of the winding of said electromagnet, and means operated by the movement of said armature for connecting said resistance in parallel with said winding and for opening the circuit of said winding.

2. In combination, an electromagnet, a pivoted armature adapted to move back and forth under the influence of said magnet and having a predetermined period of vibration, means for registering the number of times said armature vibrates, an impedance of substantially the same value as that of the winding of said electromagnet, and means operated by the movement of said armature for connecting said impedance in parallel with said winding and for opening the circuit of said winding.

3. In combination, an electromagnet, an armature adapted to be operated by said magnet, means for registering the number of times said armature operates, impedance means of substantially the same value as that of the winding of said electromagnet, and means controlled by the operation of said armature for connecting said impedance means in parallel with said winding and for opening the circuit of said winding.

4. In combination, an electromagnet, an armature adapted to be operated by said magnet, means for registering the number of times said armature operates, a resistance of substantially the same value as that of the

winding of said electromagnet, and a make-before-break switch including a plurality of contact springs and adapted to connect said resistance in parallel with said winding and open the circuit of said winding as said armature moves to its operated position and to disconnect said resistance and close the circuit of said winding as said armature moves from its operated position.

5. In combination, an electromagnet, an armature adapted to move back and forth under the influence of said magnet, means for registering the number of times said armature vibrates, a resistance of substantially the same value as that of the winding of said electromagnet, means controlled by the movement of said armature for connecting said resistance in parallel with said winding and for opening the circuit of said winding, and means associated with said armature and adapted to cooperate with the momentum of said armature and with the magnetic properties of said magnet to cause said armature to have a predetermined frequency of vibration.

6. A measuring device comprising, in combination, an electromagnet, an armature including a balance wheel and a permanent magnet fastened thereto and adapted to rotate back and forth under the influence of said electromagnet, means for registering the number of times said armature moves through its arc of rotation, a coil spring associated with said armature and adapted to cooperate with the momentum of said armature and with the magnetic properties of said electromagnet to cause said armature to have a predetermined period of vibration, a resistance of substantially the same value as that of the winding of said electromagnet, means operated as said armature moves to its operated position for connecting said resistance in parallel with said winding for opening the circuit of said winding, and means operated as said armature moves from its actuated position for closing the circuit of said winding and for disconnecting said resistance.

7. In a telephone system, subscribers' stations, connecting circuits for establishing talking connections between said stations, a current source for supplying talking current to said stations, an electromagnet at each of said stations, the winding of which is normally connected in series with the circuits of said stations, an armature adapted to move back and forth under the influence of said electromagnet, means for registering the number of times said armature vibrates, a resistance at said stations of substantially the same value as that of said winding and adapted to be normally disconnected from the circuits of said stations, and means controlled by the movement of said armature for connecting said resistance in parallel with said

winding and for disconnecting said winding.

8. In a telephone system, subscribers' stations, connecting circuits for establishing talking connections between said stations, a current source for supplying talking current to said stations, an electromagnet at each of said stations adapted to be operated at predetermined intervals of time by the talking current and independently of variations thereof, the winding of said magnet being normally connected in series with the circuits of said stations, an armature adapted to move back and forth under the influence of said magnet and having a predetermined period of vibration, means for registering the number of times said armature vibrates, a resistance at said stations of substantially the same value as that of said winding and adapted to be normally disconnected from the circuits of said stations, and means controlled by the movement of said armature for connecting said resistance in parallel with said winding and for disconnecting said winding.

9. In a telephone system, subscribers' stations, connecting circuits for establishing talking connections between said stations, a current source for supplying talking current to said stations, an electromagnet at each of said stations, the winding of which is normally connected in series with the circuits of said stations, an armature adapted to be operated by said magnet, means for registering the number of times said armature operates, a resistance at said stations of substantially the same value as that of said winding and adapted to be normally disconnected from the circuits of said stations, and means adapted to connect said resistance in parallel with said winding and open the circuit of said winding as said armature moves to its operated position and to connect said winding in parallel with said resistance and disconnect said resistance as said armature moves from its operated position.

In testimony whereof, I have signed my name to this specification this 12th day of June 1929.

IRVING W. GREEN.