Sept. 12, 1933. W. H. EDWARDS 1,926,143

TIME CONTROLLED APPARATUS

Filed June 14, 1929 2 Sheets-Sheet 1

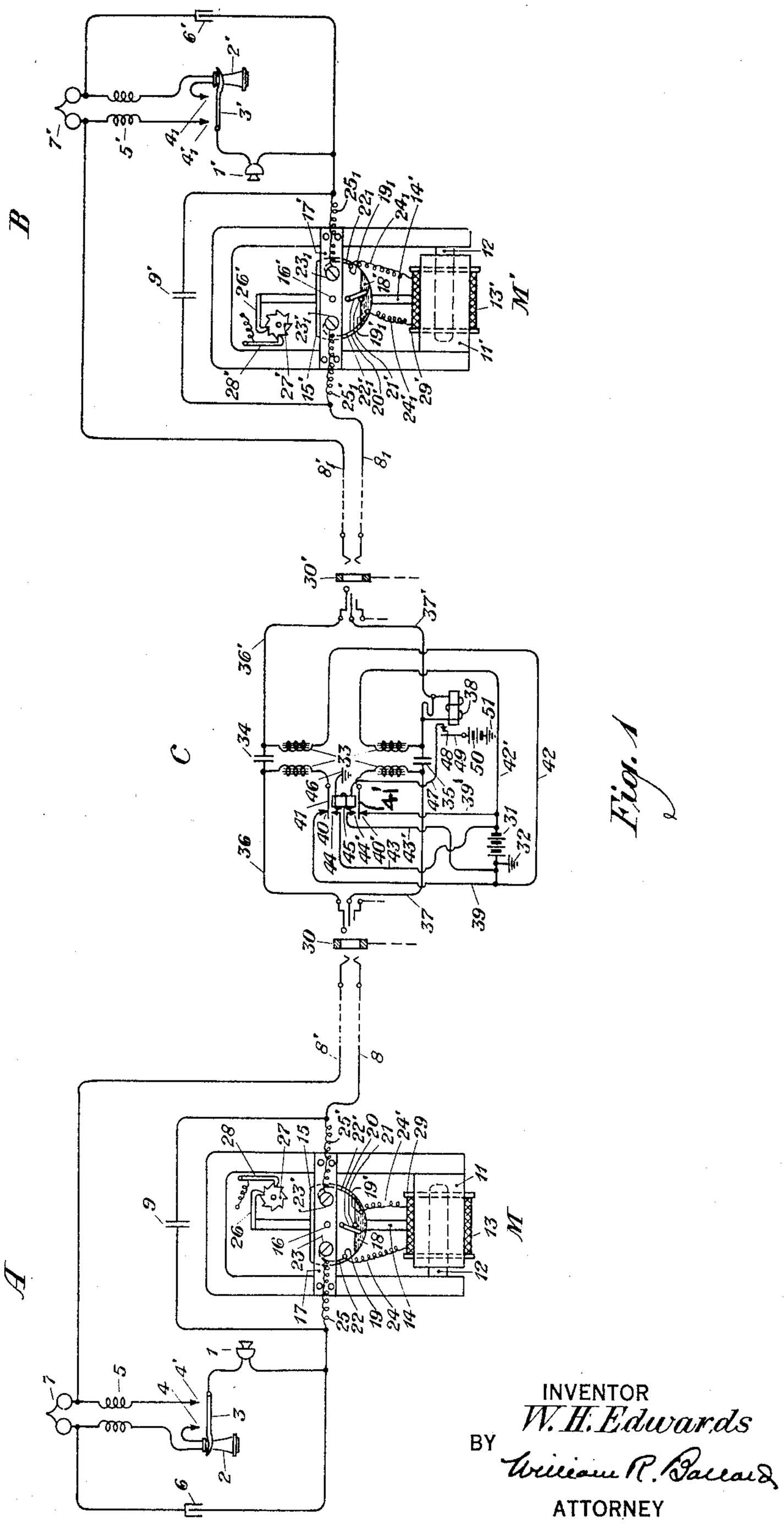

Fig. 1

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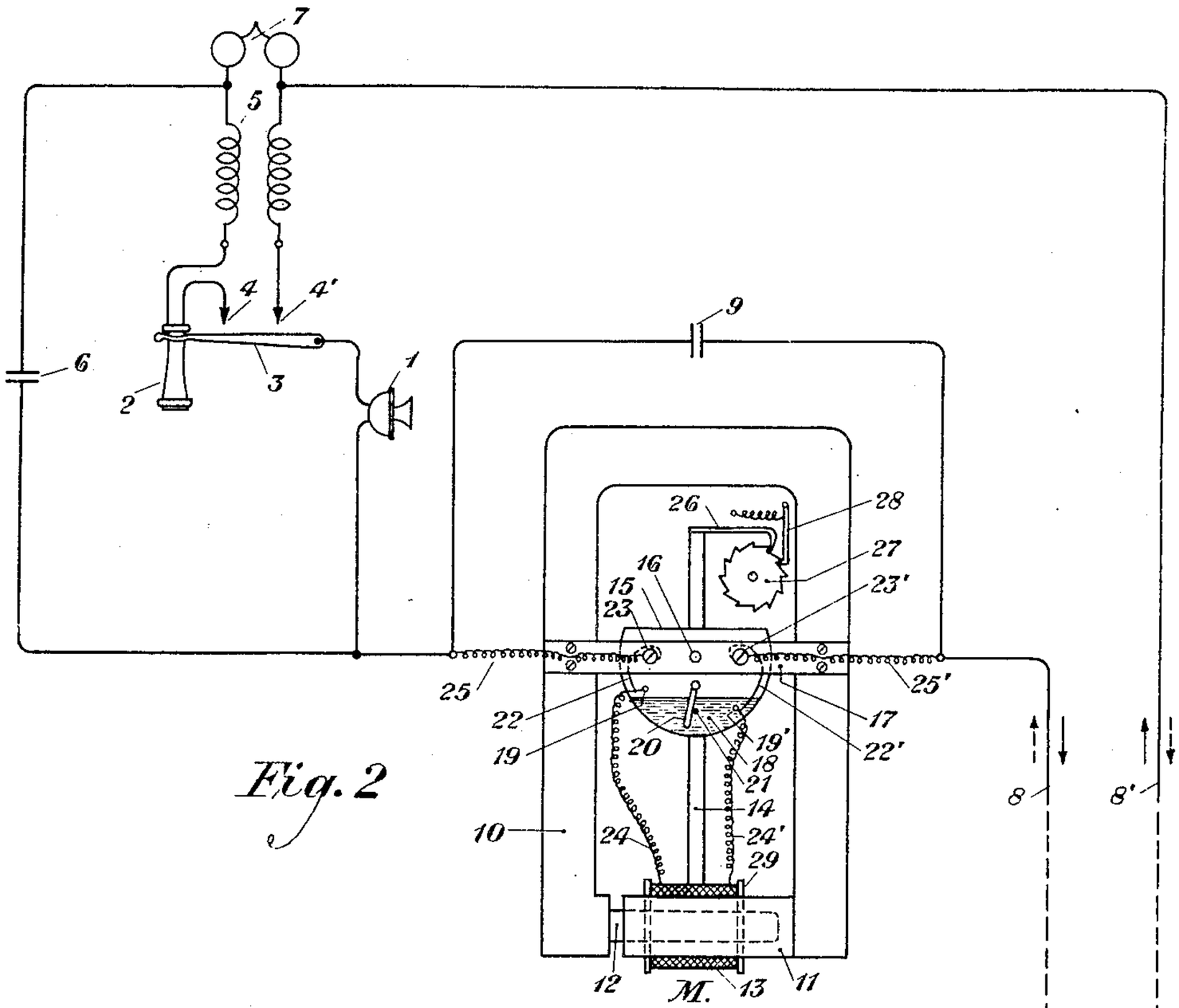

Fig. 2

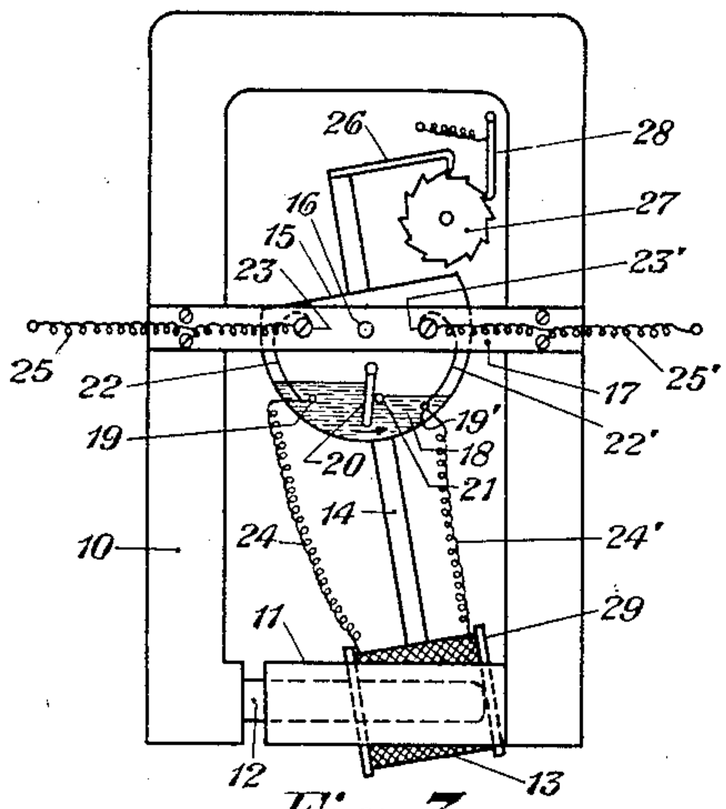

Fig. 3

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Patented Sept. 12, 1933 1,926,143

UNITED STATES PATENT OFFICE

1,926,143

TIME CONTROLLED APPARATUS

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Application June 14, 1929. Serial No. 370,960

4 Claims. (Cl. 171—272)

This invention relates to timing devices, and more particularly to automatic time measuring devices adapted to be located at the subscribers' stations of a telephone system, each device being 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 the meter was located at the subscriber's station, it was found necessary, in order that the meter be operated automatically 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, in combination with a mercury switch which at definite intervals of time, automatically and independently of line current variations, shunts said meter out of the circuit and causes it to record the length of each conversation but which does not require the lifting of the mercury therein in opposition to the force exerted by the magnetic field each time the switch is operated.

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

Figure 1 of the drawings represents diagrammatically a telephone system illustrating one embodiment of the invention; Fig. 2 is an enlarged view of one of the stations of Fig. 1; Fig. 3 shows diagrammatically the same embodiment of the meter in its operated condition.

In Fig. 1, two subscribers' stations A and B are shown with subscribers' loops extending to the central office and terminating in the jacks 30 and 30'. 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, the contacts 4 and 4', the induction coil 5, the condenser 6, the ringer 7 and the line conductors 8 and 8'. In addition, there is located at the substation a meter M connected in series with the substation circuit with a by-pass condenser 9 provided to permit the voice signals to pass therethrough rather than through the meter winding.

The meter M, as shown, includes a permanent magnet 10 having adjacent or overlying, parallel disposed pole pieces 11 and 12, 11 being the outer pole piece and 12 being the inner. An armature of the moving coil type, having the coil 13, the supporting member 14, and the receptacle 15, is pivoted at 16 on the cross-bar 17. The coil 13 is positioned within the outer pole piece 11 and surrounds the inner pole piece 12. The receptacle 15 contains the mercury 18, the contacts 19 and 19', the pivoted vane 20, and the vane stop 21. The contacts are permanently secured to the wall of the receptacle 21 in such a position, relative to each other, that when the armature is in its normal position, contact 19' is immersed in the mercury and the contact 19 is above the mercury, and when the armature is in its operated position, both contacts are immersed in the mercury. The vane 20 is pivoted to the walls of the receptacle so that it can swing freely under the influence of gravity and exert a substantial pressure on the mercury under the influence of the vane stop 21, which is rigidly secured to the receptacle. Coil spring conductors 22 and 22' are connected between the contacts 19 and 19', and connecting posts 23 and 23', respectively. The coil spring conductors are designed to counter-balance each other and hence do not produce any drag on the armature when it vibrates. Obviously, ordinary conductors may be used if desired. The coil 13 is connected in series with the substation circuit through the leads 24 and 24', the contacts 19 and 19', the coil spring conductors 22 and 22', the connecting posts 23 and 23', and the leads 25 and 25'. On the upper end of supporting member 14 is positioned a pawl 26 which, when the armature is vibrated, operates the ratchet wheel 27. A holding pawl 28 is also provided to hold the ratchet wheel in its operated position.

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

When battery is applied to the device so that the current flows in the direction indicated by the solid arrows in Fig. 2—that is, from lead 25 through connecting post 23, coil spring conductor 22, contact 19, lead 24, the winding of coil 13, lead 24', contact 19', coil spring conductor 22' and connecting post 23' to lead 25'—the coil is energized in such a way that it is held in its normal position as shown in Fig. 2, the shunt circuit, which includes contacts 19 and 19' and the mercury, remains open and no registration occurs. When battery is applied to the device so that the current flows in the direction indicated by the

dotted arrows in Fig. 2, that is, in the opposite direction, registration begins.

With this direction of current flow through the coil 13, said coil moves away from its normal position, shown in Figs. 1 and 2, through the magnetic field to the position shown in Fig. 3. This movement of the coil, through the supporting member 14, causes the pawl 26 to operate ratchet wheel 28 one step and rotates the receptacle 15, along with the contacts 19 and 19′ and the vane stop 21, to the position shown in Fig. 3. The rotation of the receptacle in this direction does not affect the level of the mercury. Hence, no force, which would ordinarily be present due to the lifting of the mercury, is exerted in opposition to that exerted by the magnetic field in moving the armature to its operated position. The vane 20, due to the movement of the vane stop 21 with the armature, slowly moves to a perpendicular position under the influence of gravity without exerting any appreciable pressure on the mercury or raising its level. As soon as the contact 19 becomes immersed in the mercury, its electrical connection with the contact 19′ is completed and the shunt circuit around the coil 13 is closed. The coil is deenergized and tends to restore to its normal position due to the force of gravity. As the armature restores to its normal position, the vane stop 21 comes in contact with the vane 20 and exerts a substantial pressure thereon. The vane, in turn, exerts this pressure on the mercury present in one side of the receptacle. The vane presents a restricted opening to the passage of the mercury to the other side of the receptacle. Hence, the level of the mercury in one side of the receptacle will be raised, and the connection between the contacts 19 and 19′ will be maintained during the time the armature is restoring to its normal position. The mercury will continue to flow slowly through the restricted opening until the level of the mercury in both sides of the receptacle becomes the same. At this time, the contact 19 is no longer in contact with the mercury and the shunt circuit is open. The coil 13 is again energized in such a way that it again moves to the position shown in Fig. 3, and causes the ratchet wheel to be operated another step and the level of the mercury raised as before. This cycle is repeated at definite time intervals as long as the connection between the subscribers is maintained, and the time of each conversation is registered without any substantial, artificial or abnormal variation of the line current.

In order to prevent false registration due to the ringing current or to the flashing of the receiver hook, the mass of the armature is so selected that the moment of inertion thereof will be sufficient to provide sluggishness of action. Also, for this purpose eddy current damping means in the form of a copper slug 29 inside the coil 13, is provided to retard the build-up and decay of the current in the coil.

As described above, only the current in the calling subscriber's line is reversed and hence only the meter at the calling subscriber's station is operated. Also, as described, this reversal occurs only after the called subscriber answers. It is to be understood, however, that the current in both subscribers' lines may be reversed and/or this reversal may be caused to occur, and hence the meter or meters may be caused to begin operating, at any desired time during the connection, without departing from the spirit of the invention.

What is claimed is:

1. In combination, a magnet having adjacent pole pieces, a coil adapted to move between said pole pieces, a supporting member fastened to said coil and adapted to be moved thereby to its actuated position when said coil is energized and to be moved back to its normal position by gravity when said coil is deenergized, means for registering the number of times said supporting member moves through its arc of vibration, a receptacle containing a liquid conducting medium fastened to said supporting member and adapted, when said coil is energized, to be tilted without raising the level of said liquid conducting medium, a circuit including a pair of terminals within said receptacle and adapted to shunt said coil, means for retarding the flow of said conducting medium from one side of said receptacle to the other, and means for causing said retarding means to raise the level of said conducting medium in one side of said receptacle as said supporting member returns to its normal position.

2. In combination, a magnet having adjacent pole pieces, a coil adapted to move between said pole pieces, a supporting member fastened to said coil and adapted to be moved thereby to its actuated position when said coil is energized and to be moved back to its normal position by gravity when said coil is deenergized, means for registering the number of times said supporting member moves through its arc of vibration, a receptacle containing a liquid conducting medium fastened to said supporting member and adapted, when said coil is energized, to be tilted without raising the level of said liquid conducting medium, a circuit including a pair of terminals fastened within said receptacle and adapted to shunt said coil, one of said terminals being immersed in said conducting medium and the other being positioned above the level thereof when said supporting member is in its normal position and both of said terminals being immersed in said conducting medium when said supporting member is in its actuated position, and means within said receptacle for raising the level of said conducting medium in one side of said receptacle to keep both of said terminals immersed as said supporting member returns to its normal position and for maintaining said conducting medium at its raised level a predetermined interval of time.

3. In combination, a magnet having adjacent pole pieces, a coil adapted to move between said pole pieces, a supporting member fastened to said coil and adapted to be moved thereby, means for registering the number of times said supporting member moves through its arc of vibration, a receptacle fastened to said supporting member and containing a conducting fluid, a circuit including a pair of terminals within said receptacle and adapted to shunt said coil, the movement of said supporting member in one direction in response to the effective energization of said coil being adapted to close said shunt circuit without raising the level of said fluid, and means for raising the level of said fluid in one side of said receptacle as said supporting member moves in the opposite direction and for maintaining said fluid in its raised level a predetermined interval of time.

4. In combination, a permanent magnet, one pole piece of which overlies the other, a coil adapted to move between said pole pieces, a pivoted supporting member fastened to said coil and adapted to be moved thereby to its actu-

ated position when said coil is energized and to be moved back to its normal position by gravity when said coil is deenergized, means for registering the number of times said supporting member moves through its arc of vibration, a receptacle containing mercury fastened to said supporting member and adapted, when said coil is energized, to be tilted without raising the level of said mercury, a circuit including a pair of terminals within said receptacle and adapted to shunt said coil, one of said terminals being immersed in said mercury and the other being positioned above the level thereof when said supporting member is in its normal position, a pivoted vane immersed in said mercury and adapted to retard the flow of said mercury from one side of said receptacle to the other, and a bar member fastened to said receptacle and adapted to cause said vane to raise the level of the mercury in one side of said receptacle when said supporting member moves from its actuated position to its normal position.

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