

March 4, 1930.

F. C. BISBEE

1,749,015

METER

Filed Dec. 14, 1927

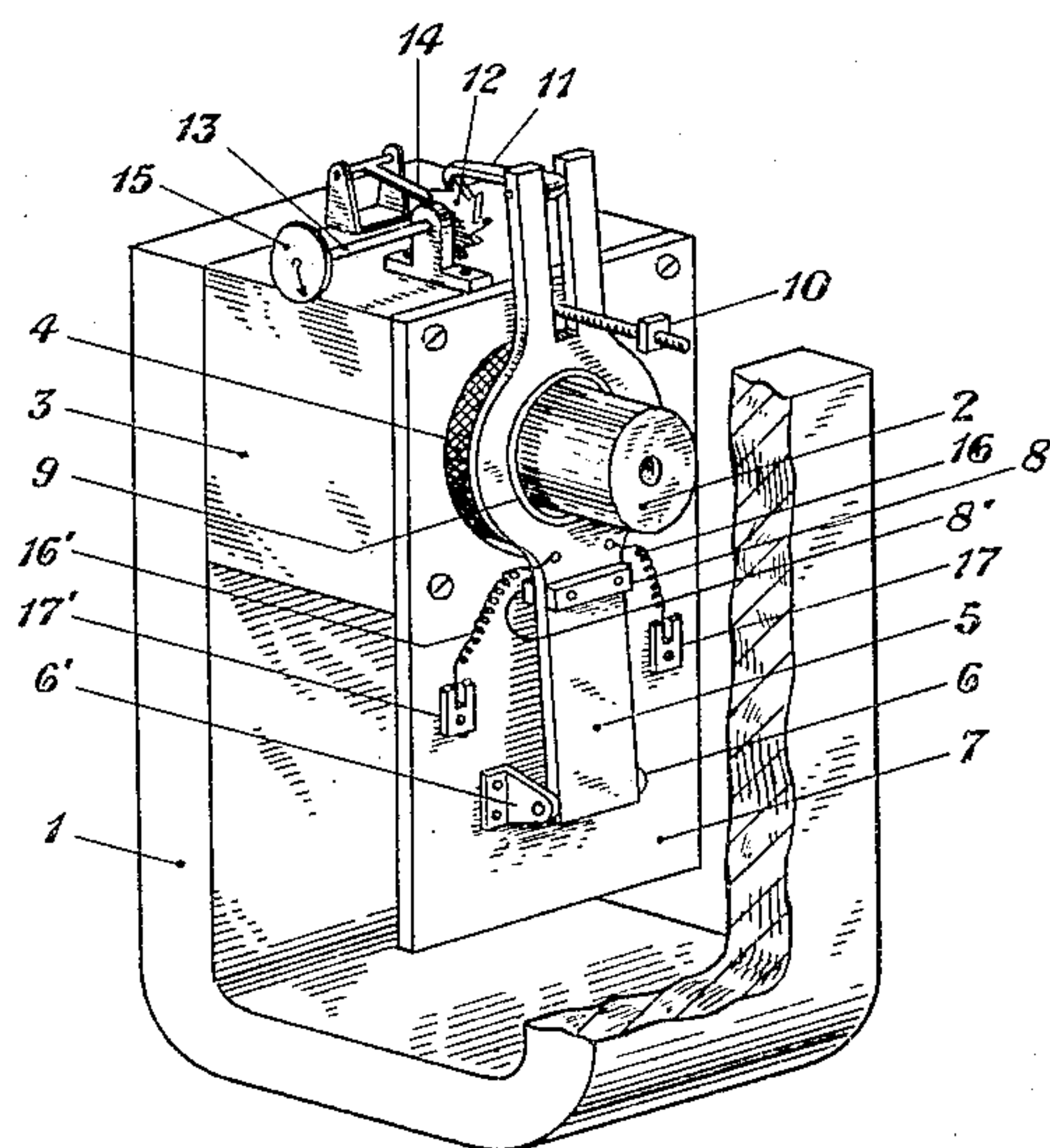


Fig. 1

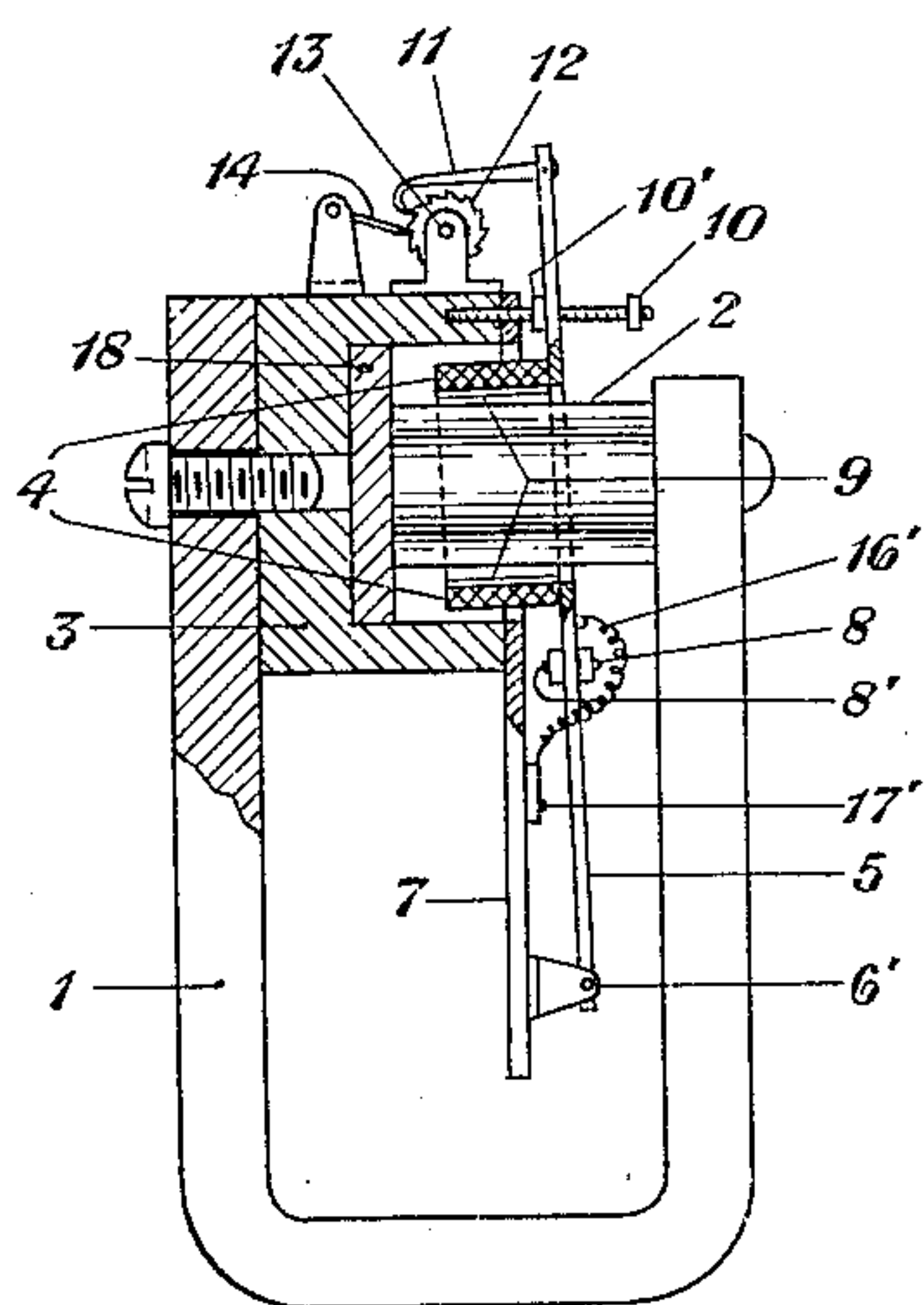


Fig. 2

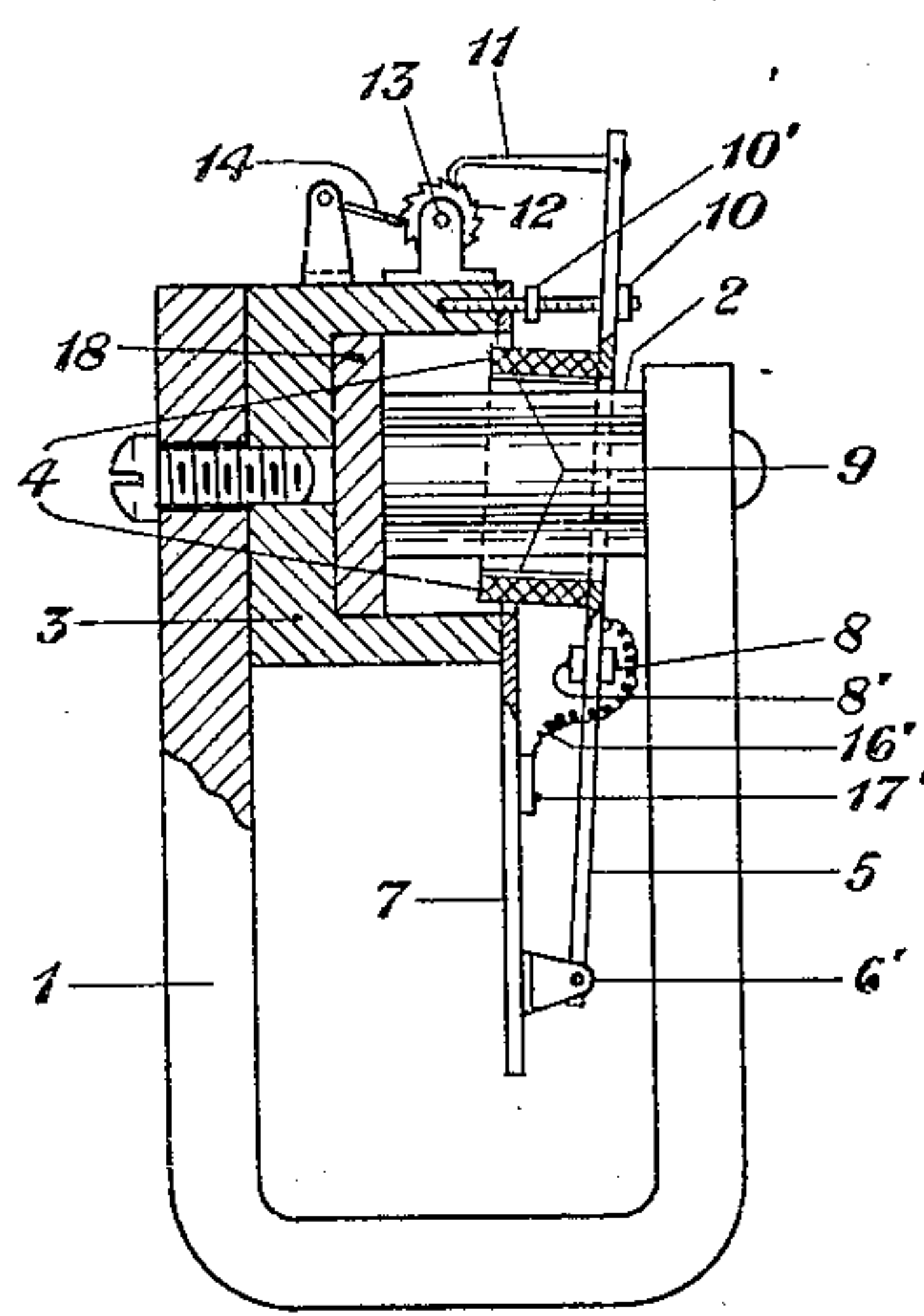


Fig. 3

INVENTOR

F. C. Bisbee

BY

ATTORNEY

UNITED STATES PATENT OFFICE

FREDERICK C. BISBEE, OF ELIZABETH, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

METER

Application filed December 14, 1927. Serial No. 239,931.

This invention relates to measuring devices, and more particularly to telephone meters by means of which a subscriber is charged for the length of time his telephone is in actual use.

In telephone metering systems, it has been proposed to operate the meter periodically by varying the current or reversing the direction of the flow of the current in the telephone circuit. The present invention is adapted for use in connection with such systems.

In the moving coil armature type of meter, a device has been suggested in which the armature is mounted in a vertical position and vibrates in a manner similar to that of an inverted pendulum. The armature, due to its mass, is acted upon by the force of gravity and tends to remain in or restore to either extreme position of its arc of vibration when the coil is deenergized.

The present invention consists of a stationary permanent magnet having concentric pole pieces, a movable coil surrounding the inner pole piece of said magnet and fastened to one end of an armature and soft iron bars fastened to said armature, which armature is supported at its other end by pivotal means. The moving parts may be made so light that the effect of the force of gravity acting thereon is relatively negligible when the device is mounted in any position. The magnetic attraction of the pole pieces of the magnet on the soft iron bars tends to cause the armature to remain in or restore to either extreme position.

It is essential in the moving coil type of armature that when the telephone is in actual use, the meter be as sensitive as possible to the small line current and that when the telephone conversation ceases, the armature remain in or restore to either extreme position rather than the mid-position in its arc of vibration. If the armature does not restore to either extreme position, false registration will result when the subscriber attempts to recall the operator by flashing, or during dialing. Therefore, it is essential that the force tending to restore the armature to either extreme position be as great

as possible at any given point on its arc of vibration between its mid-position and either extreme position, without at the same time rendering the device inoperative to the small line current. From the viewpoint of practical design it is also essential that the arc of vibration of the armature be comparatively small.

The resultant restoring force exerted on the armature of the meter hitherto employed is dependent primarily upon the force of gravity. Decreasing the arc of vibration decreases the overbalance or the vertical distance through which the center of gravity of the armature is moved. This decreases the restoring force exerted on the armature at any given point on its arc of vibration between its mid-position and either extreme position.

The resultant restoring force exerted on the armature of the meter constituting the present invention is dependent primarily upon the attraction of the pole pieces of the permanent magnet on the soft iron bars fastened to the armature. Decreasing the arc of vibration decreases the horizontal distance through which the soft iron bars are moved. This increases the restoring force exerted on the armature at any given point on its arc of vibration between its mid-position and either extreme position, when the distance between the pole piece and the extreme position of the armature is constant, because the soft iron bars are in closer proximity to the source of the magnetic attraction at all points along its path of travel. Therefore, with equal arcs of vibration of the armatures, and with equal restoring force exerted on the armatures at their extreme positions, the restoring force exerted on the armature of the present invention at any given point on its arc of vibration between its mid-position and either extreme position is greater than that exerted on the armature of the meter hitherto employed at the corresponding point on its arc of vibration.

It is the object of this invention to provide a meter which is sensitive to small line current, which is sufficiently positive in the biasing effect of its armature to prevent false

registration, which may be mounted in any position with equally efficient results, and which is inexpensive in initial cost and subsequent maintenance.

5 Figure 1 of the drawing is a perspective view of the meter; Fig. 2 is a side view broken away when the moving coil armature is in one of its extreme positions, the indicator not being shown; and Fig. 3 is the same view
10 when the moving coil armature is in the other of its extreme positions. Corresponding elements are indicated by the same numerals.

In the drawing, the stationary permanent magnet 1 has adjacent or concentric pole pieces, 2 being the inner pole piece and 3 being the outer. A member 18, preferably made of brass or other similar material, separates the outer pole piece from one end of the inner pole piece. The movable armature coil 4 is secured to the coil-arm 5 which is supported by the pivotal elements 6 and 6' fastened to the plate-support 7, which is preferably made of brass or other similar material. Bars 8 and 8' of soft iron or other magnetic material are fastened to the armature 5 at a point within the magnetic field between two poles of the magnet. The pole piece 3 and the opposite pole of the permanent magnet may be employed to exert the magnetic attraction on these bars, but additional pole pieces or another magnet may be provided for this purpose. The magnetic attraction on these bars constitutes a restoring force tending to pull the armature, to which they are fastened, to either extreme position of its arc of vibration. When the coil is energized by the line current, the force causing the coil to move in the magnetic field between the concentric pole pieces is greater than the magnetic attraction exerted on the bars tending to cause the armature to remain in or restore to either extreme position. When the coil is deenergized, the force causing the coil to move in the magnetic field between the concentric pole pieces is removed and the magnetic attraction on the bars immediately becomes sufficiently positive to cause the armature to remain in or restore to either extreme position. The positiveness of the restoring force may be adjusted by moving the bars along the armature toward or away from the center of the magnetic field between the pole pieces exerting a magnetic attraction thereon. The fact that when the coil is deenergized the armature always remains in or restores to either extreme position, prevents false operation of meter when the current is interrupted, as when the subscriber attempts to recall the operator by flashing, during dial, or at the termination of the call, which would occur if the armature restored to the mid-position when the current is interrupted. Also, the magnetic attraction on the bars 8 and 8' provides sufficient retentive force to prevent response to

large forces of short duration, for example, mechanical vibration of the meter or the current used for ringing signals. Sluggishness of action with light moving parts is obtained by the use of eddy current damping by means of a copper slug 9 inside the coil which is acted upon by the field of the permanent magnet. A bolt and nuts 10 and 10' are provided to serve as stops when the armature reaches its extreme positions. These stops are made adjustable in order that the arc of vibration may be regulated.

In the particular embodiment shown, the armature is supported by the pivots 6 and 6' and the coil is energized by the current through the terminals 17 and 17', fastened to the support 7, and wires 16 and 16'. However, it is to be understood that other pivotal means, for example, insulated spring reeds which serve as conductors or a single spring reed may be used instead of the arrangement shown. Likewise, two coils, one connected in each side of the line, may be used instead of a single coil. In such case four spring reeds or four lead-in wires would be provided.

There is connected to the armature a pawl 11 which operates a ratchet-wheel 12. The rotation of the ratchet-wheel in turn operates, by means of the connecting rod 13, the indicator 15. A holding pawl 14 is provided to hold the ratchet-wheel in its rotated position. This invention is not limited to the specific arrangement of the registering means disclosed. Different arrangements may be employed when the meter is mounted in other positions.

During manufacture, the strength of the magnet, the dimensions of the soft iron bars, and the size of the arc may be selected so that the device will be sensitive to the small line current when the coil is energized and so that the magnetic attraction on the cores will be sufficiently positive to insure the armature's remaining in or restoring to either extreme position when the coil is deenergized. Also, the moving parts may be made so light that the force of gravity acting thereon will be relatively negligible and the meter may be mounted in any position with equal efficiency of operation. The fact that the device may be mounted in any position eliminates the danger of false registration, due to the creeping of the meter on its supports out of position, which is caused by vibration of the supporting structure.

The meter is designed so that the armature will be in either one of its extreme positions at all times when the subscriber's telephone is not in use. The operation of the device is as follows: At the beginning of the conversation, the direction of the flow of current is, for example, through the terminal wire 16, the winding of the coil 4, and the other terminal wire 16'. The coil is energized in such a way, for example, that the coil is

moved away from the position shown in Fig. 2 through the field created between the pole pieces. This movement of the coil through the field between the two pole pieces moves the coil arm 5 to its extreme position, as shown in Fig. 3. This movement, by means of the pawl 11, rotates the ratchet-wheel 12, which in turn, by means of the connecting rod 13, operates the indicator 15. When the direction of the flow of the current is reversed, the current flows through the terminal wire 16', the winding of the coil 4, and thence back through the other terminal wire 16. With this direction of the current the coil moves away from the position shown in Fig. 3 through the magnetic field between the two pole pieces. This movement of the coil through the field between the two pole pieces moves the armature arm 5 back into the other extreme position as shown in Fig. 2. This movement again places the pawl 11 in position to rotate the ratchet-wheel when the current is reversed again. During the first half of the movement of the armature through its arc the magnetic attraction on the bars 8 and 8' is opposing the movement, but this is counteracted by the fact that the force causing the coil to move in the magnetic field between the concentric pole pieces is greater than the magnetic attraction on the bars. During the latter half of the travel the magnetic attraction on the bars is assisting the movement. When the coil is deenergized, the force causing the coil to move in the field between the concentric pole pieces is removed and the magnetic attraction on the bars immediately becomes sufficiently positive to cause the armature to remain in or restore to either extreme position.

This invention may be used in connection with systems in which the current is suddenly reversed or in which the current is gradually reversed. Also, by providing a spring or by suitable adjustment of the meter so that the coil arm will be restored after operation to the position illustrated in Fig. 2, this invention may be used in connection with systems using pulsating currents to operate the meter. Under certain conditions it may be desirable to bias the meter by a spring or by adjustment of magnetic bars 8 and 8' so that the armature would tend to restore to or remain in the position to which it is operated by the normal line battery polarity. Furthermore, the use of the meter described is not limited to systems in which the subscriber is charged for the length of time his telephone is in use but may be employed in systems where the charge is made on a message basis.

It is to be understood that this invention, although disclosed in the particular embodiment herein set forth, is capable of being embodied in other forms without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In combination, a magnet having adjacent pole pieces, a coil armature adapted to move between said pole pieces, pivotal means supporting said armature, and magnetic means fastened to said armature and adapted to be influenced by said magnet.

2. In combination, a magnet having concentric pole pieces, an armature supported by pivotal means, a coil fastened to said armature and adapted to move between said pole pieces, and magnetic means fastened to said armature and adapted to be attracted by said magnet.

3. In combination, a permanent magnet one pole piece of which surrounds the other, a coil armature adapted to move through the magnetic field between said pole pieces under the influence of currents of opposite polarities, pivotal means supporting said armature at one end thereof, bars of magnetic substance fastened to said armature within the field of said magnet and adapted to be attracted by pole pieces of said magnet whereby said armature will remain only in either extreme position in its arc of vibration when said coil is deenergized.

4. In combination with a permanent magnet having concentric pole pieces and a coil armature supported by pivotal means and adapted to move between said pole pieces, magnetic means fastened to said armature within the field of said magnet and adapted to be influenced by said magnet.

In testimony whereof, I have signed my name to this specification this 12th day of December, 1927.

FREDERICK C. BISBEE.