No. 660,987. Patented Oct. 30, 1900.

P. EIBIG.

ELECTRICITY METER.

(Application filed Oct. 7, 1899.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1

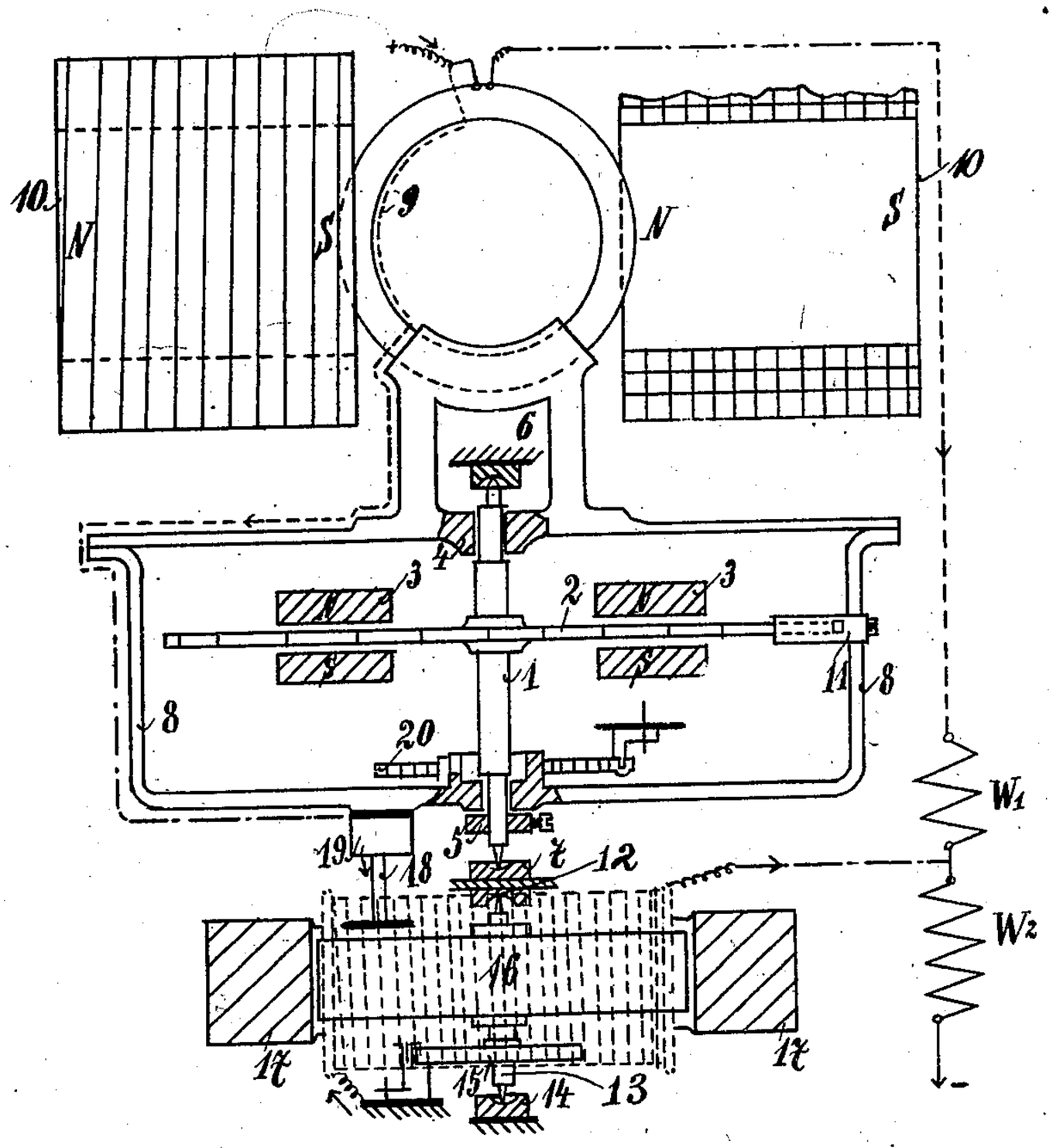

Fig. 2

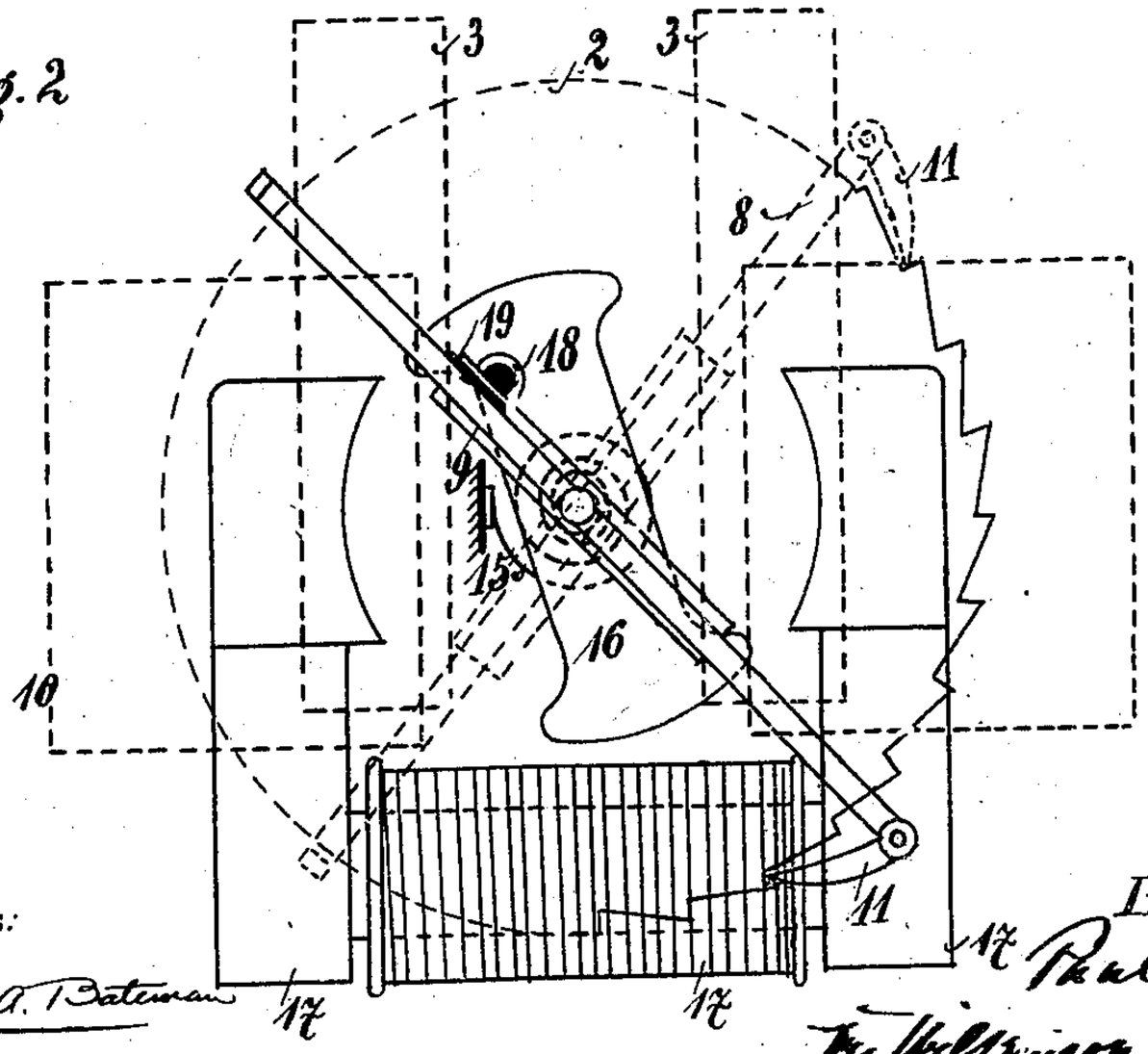

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Fig. 3.

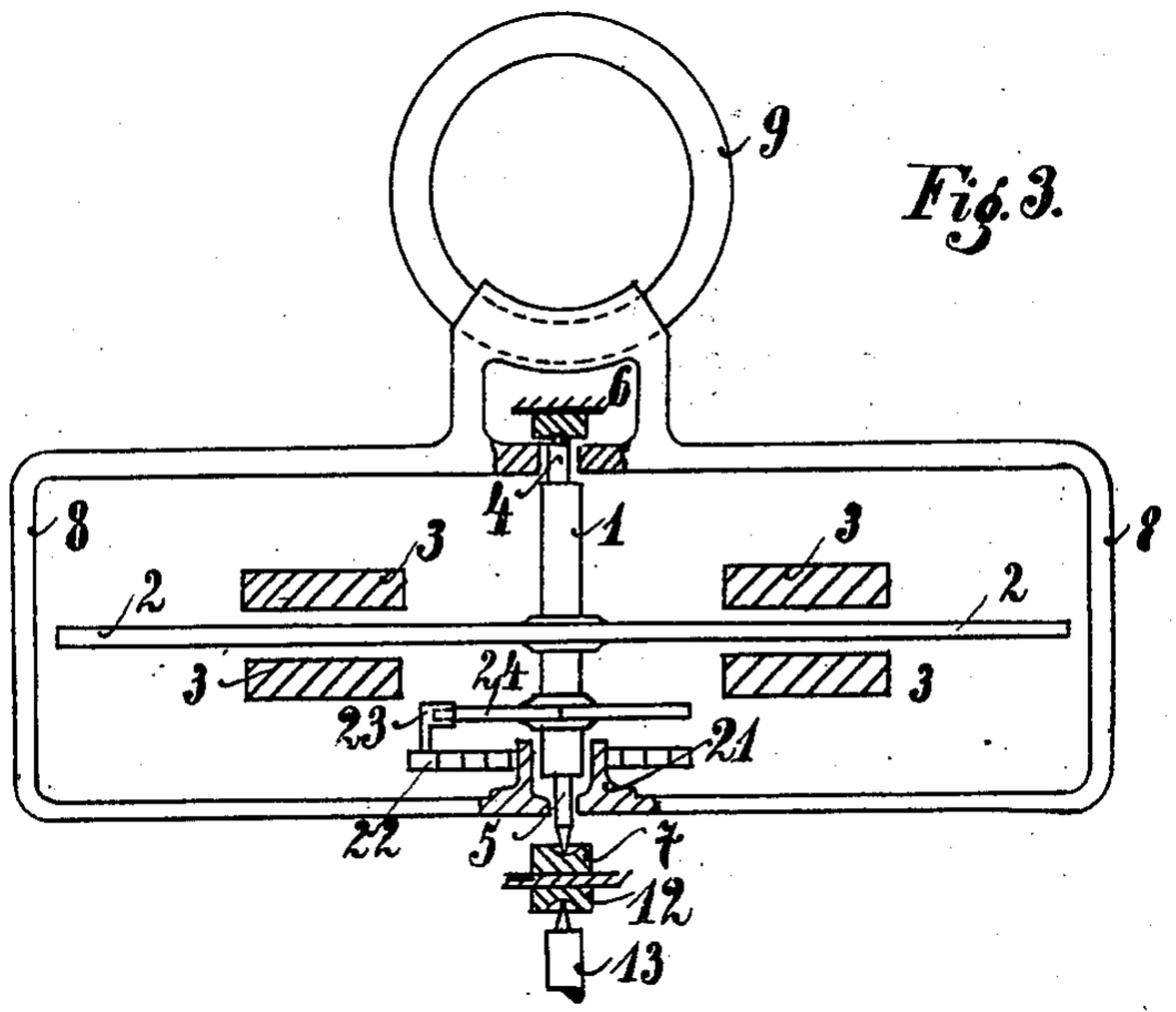

Fig. 4.

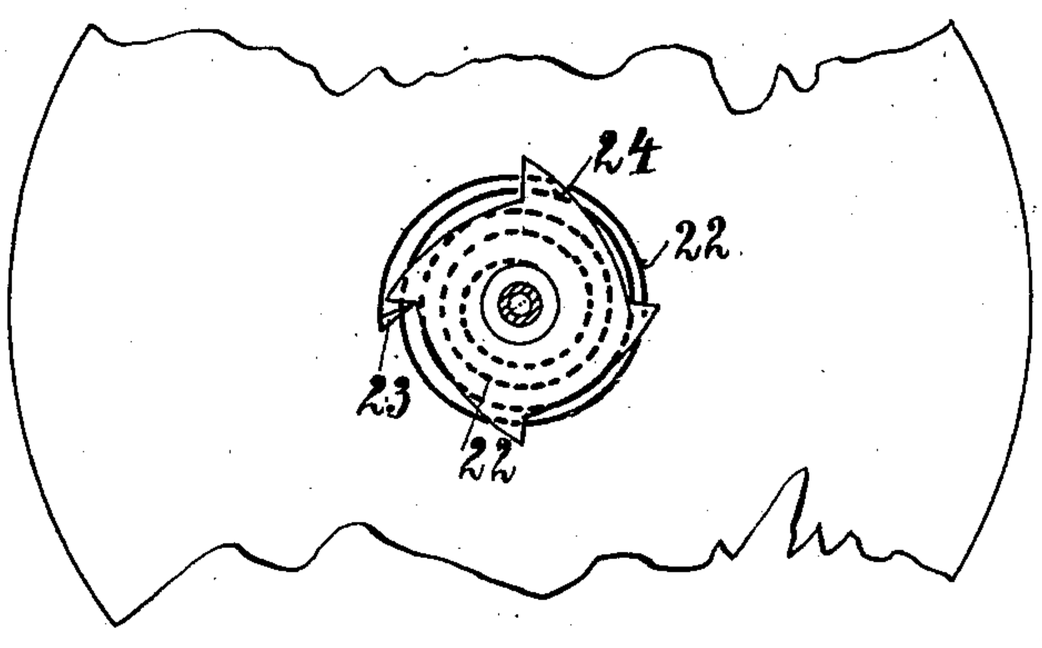

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Fig. 5.

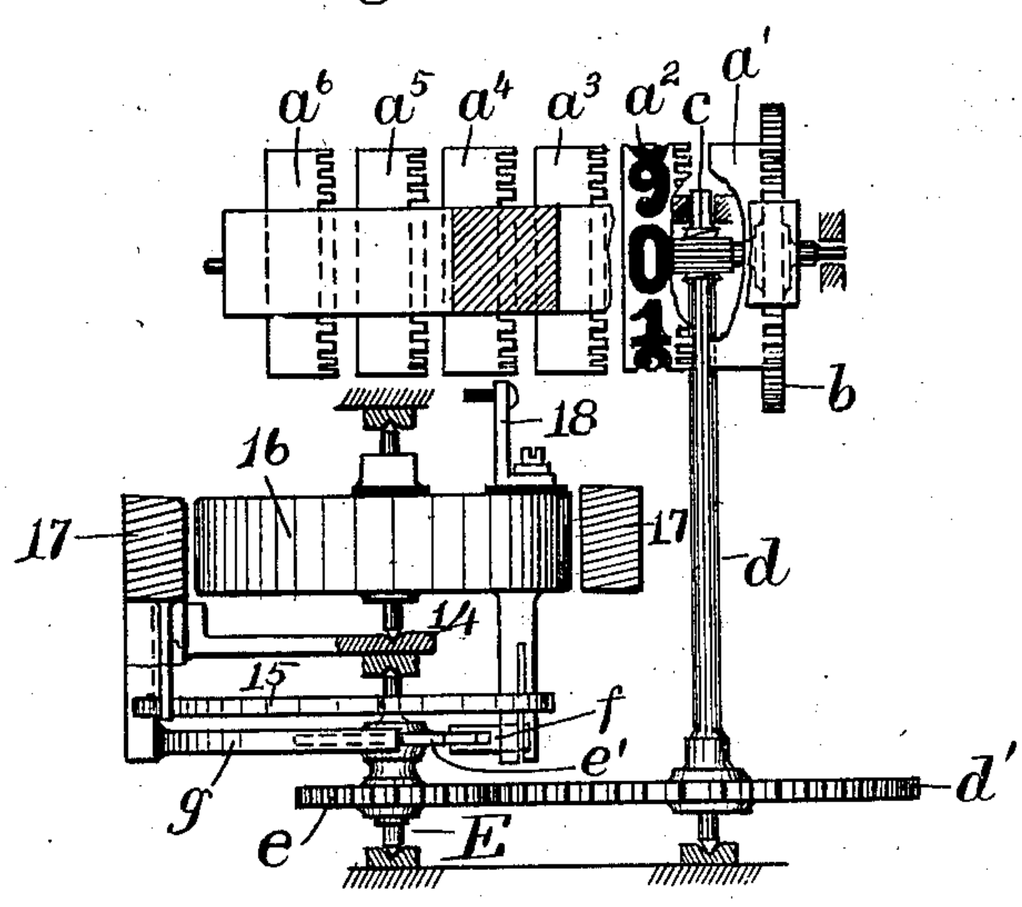
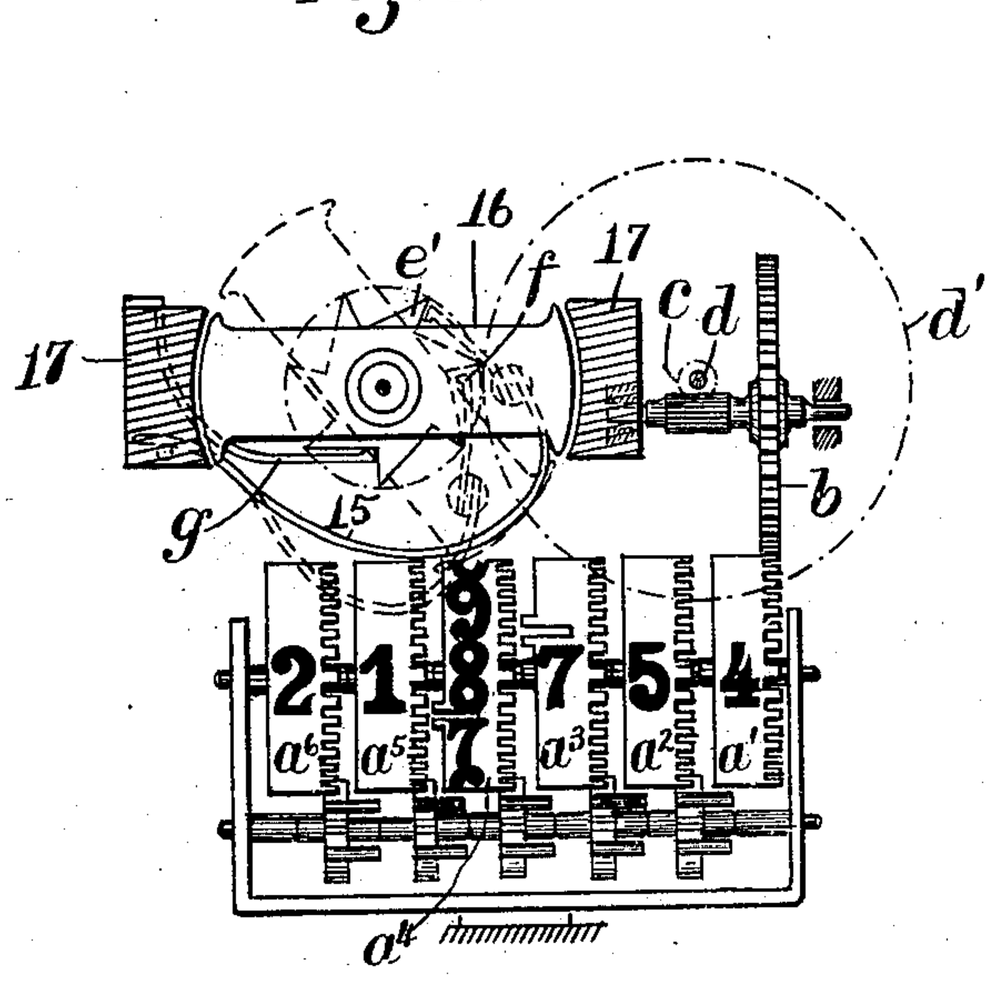


Fig. 6.



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UNITED STATES PATENT OFFICE.

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ELECTRICITY-METER.

SPECIFICATION forming part of Letters Patent No. 660,987, dated October 30, 1900.

Application filed October 7, 1899. Serial No. 732,945. (No model.)

To all whom it may concern

Be it known that I, PAUL EIBIG, mechanical engineer, a subject of the German Emperor, residing at 60 Alexandrineustrasse, in the city of Berlin, Germany, have invented new and useful Improvements in or Relating to Electricity-Meters, of which the following is a specification.

In the case of electricity-meters having a regular reciprocating movement of a pressure-coil, situated in the field of the current-coils it is necessary, owing to insufficient power of the automatically-swinging coil for actuating the registering apparatus and contact devices, to switch in a so-called "relay" and a special starting-coil for the purpose of overcoming the frictional resistances. The change in direction of the oscillations of the movable coil also renders it difficult to obtain an exact proportionality, owing to the force of momentum of the brake-disk or other brake or regulating device involved in the movement, inasmuch as with the increase of speed of oscillation the momentum of inertia tends to act in the contrary way. In the electricity-meter according to this invention these drawbacks are avoided by so arranging the swinging coil that it becomes effective only in one direction of its movement, being returned after each oscillation in that direction to its original position by means of an electromagnet automatically excited at that moment. In this returning movement the pressure-coil is disengaged from its damper or brake-disk or counting-disk, which participates only in the movement of the coil in its outward or active oscillation, its momentum of inertia therefore becoming evident only in one direction in such a manner that the oscillations are assisted in proportion to the increase of speed. The force of momentum during the return movement of the coil is also used to overcome the resistance to movement due to friction and inertia for the registration of weak charges by correspondingly setting a starting-spring or the like and also for working the contact devices for the registering apparatus.

It will be understood that the movement of the registering device is effected by two separate movements—viz., the more or less rapid movement of the pressure-coil produced in one direction, proportional to the consumption of current and under the influence of the damping or brake device, and its more rapid return movement, caused by the movement of the returning armature of the electromagnet and of the movement of the damper or brake device, consisting, for instance, of a copper disk rotating within a magnetic field, which during the operating movement of the pressure-coil is coupled with the latter and moves with it at a speed corresponding to the amount of consumption of current, while it is disconnected during the return movement of the pressure-coil and still moves, owing to its inertia, more or less in the outward direction until it is again engaged and rotated on the renewed operating oscillation of the coil. The working effects, however necessary for operating the contacts, the registering work of the meter, and the like are not obtained from the measuring system, but from a separately-working electromagnet, which, however, is connected with the first-named system.

Reference is had to the accompanying drawings, in which the same parts are designated by the same characters of reference throughout the several views, and in which—

Figure 1 is a front view of the device. Fig. 2 is a plan view of the same. Figs. 3 and 4 represent modifications in details. Figs. 5 and 6 are detail views showing the manner of operating the counter.

The movable pressure-coil 9, arranged between the fixed principal current-coils 10, is carried on a frame 8, revolubly pivoted at 4 and 5 around the brake-spindle 1 and provided with a clutch or pawl 11 or equivalent coupling device on the one hand and on the other with a contact-plate 19. The spindle rotates in the bearings 6 and 7 and carries a rotating damper-disk 2, moving between the magnets 3 3. Axially in line with the spindle 1 is another spindle 13, mounted in bearings 12 and 14, on which spindle is placed an armature 16, moving in the field of the electromagnet 17. The armature 16 is returned to its normal position by a spring 15 and is provided with a carrier or contact-pin 18, so that when the latter comes in contact with the

contact-plate 19 the electromagnet 17 is excited, causing a rapid rotation of the contact-plate 19 to the left, and with it of course the frame 8, the pressure-coil 9 being therefore also returned to its original position.

The operation is as follows: During the outward or active oscillation the pressure-coil 9 will swing, owing to the electrodynamic effect of the stationary current-coils 10, in one direction—say to the right—whenever current passes through the coils 10. In this movement of the solenoid 9 the brake-disk 2 will also participate, owing to the arrangement of the pawl 11, which engages in the toothed periphery of the disk 2. At the end of this oscillation—measuring, say, ninety degrees—the contact-plate 19 strikes against the pin 18, fixed to the armature 16 of the electromagnet. The contact 18 19 is thus closed, the electromagnet 17 excited, and consequently the armature 16 is attracted and rotates to the left. By this rotation the frame 8, and with it the pressure-coil 9, is returned to its original position with great speed, owing to the pressure of the pin 18 on the plate 19. During this return movement the pawl 11 slides freely over the rim of the disk 2. The latter therefore is not involved in the return movement and consequently remains during the time of such return movement of the pressure-coil 9 either stationary or even moves onward, according to the strength of the impulse which it received during the outward oscillation, such excess distance in the direction to the right being in proportion to the momentum of inertia of the device. During the return movement of the pressure-coil to its initial position, caused by the electromagnet-armature 16, the intimate contact of the pin 18 and plate 19 is assured, owing to the pressure of the two contact parts. Moreover, a weak spiral spring 20 is so arranged that it becomes set during this return movement of the coil 9, the inner end of the spring being fastened to the frame 8 and the outer end arranged so that it will assist during the next measuring period—*i. e.*, during the next swinging to the right of the pressure-coil 9, caused by the electromagnetic effect on the chief coils 10, and thereby facilitate starting when the consumption is very small. The electromagnet-armature 16, which is returned to its original position by means of a spring 15 after having been attracted and the contacts 18 and 19, separated, owing to the frame 8 continuing its oscillation to the right, serves to actuate the measuring apparatus, which is so constructed, for example, as to be moved to the extent of one tooth for every oscillation. This measuring apparatus, which is shown in Figs. 5 and 6, consists of a series of disks a' to a^6, having numbers or other characters on their periphery and geared together, so that each revolution of the first disk a' will cause the second disk a^2 to turn a predetermined part of a revolution, and each revolution of the disk a^2 will cause the disk a^3 to also make a small part of a revolution, and so on throughout the series. The first disk a' is actuated by a train of gearing consisting of a toothed wheel b, worm-gearing c, shaft d, toothed wheel d', pinion e on shaft E, and ratchet-wheel e', also on the shaft E. A pawl f on the armature 16 is arranged to engage the ratchet-wheel e' and turn the latter during the oscillation of the armature in one direction, and a spring-pawl g is arranged to engage the said ratchet-wheel and hold it from backward rotation as the armature and pawl f oscillate in the other direction. Thus a step-by-step motion is imparted to the train of gearing and through it to the counter-disks a' to a^6.

As has already been stated, the arrangement of a double oscillating system, consisting, on the one hand, of the excited coil and, on the other, of a swinging or brake device, offers the advantage that this lever of the brake may be used as a regulating means. This is the case in the apparatus represented in Figs. 1 and 2 by means of the coupling with a small toothed ratchet device of the brake-disk in so far that a spring impulse of the disk, owing to a higher charge, will be followed by a spring reaction, and consequently by an increased rotary speed or further rotation of the brake-disk, and the effect will be still more satisfactory when the brake-disk is provided with only three or four teeth. In the latter case the effect would be as follows: The pressure-coil passes, say, through an angle of ninety-two degrees, taking with it the brake-disk, which therefore would pass through the same angle. The ratchet-wheel is provided with, say, four teeth and will, after a strong impulse and owing to its own force of momentum, pass in the same direction through an additional angle while the coil is on its return journey. Say that this free continuation of the brake-disk and ratchet-disk amounts to forty-five degrees during the time that the coil is on its return movement. In consequence of such an excess oscillation the carrier of the coil when the latter makes another oscillation to the right will pass freely through an angle of forty-five degrees—*i. e.*, the next tooth of the ratchet-wheel will not be affected, and consequently the tension-coil will pass through the said angle without being affected by the brake, and consequently will obtain a greater speed. It is only after having passed through the latter half of the oscillation—*i e.*, through forty-seven degrees (ninety-two degrees minus forty-five degrees) after the carrier has reached the next tooth under the influence of the damper-disk—that the movement becomes slower and continues thus to the end of the right-hand oscillation. In the case of very weak currents this assisting effect, caused by the free oscillation and the following impulse, becomes smaller, inasmuch as the space through which the brake-disk freely oscillates and through which the coil passes in its next right-hand oscillation without being affected becomes smaller, as well as

owing to the smaller angle of free rotation—say, for instance, only twenty degrees, and so on. In this manner it is possible by making use of the effect of oscillation and of the free oscillation to recover the amount which has been lost in proportionality, owing to the time of the return movement of the coil to its original position which is not used for measuring and which in the case of stronger currents—*i. e.*, of shorter times of oscillation—is proportionately higher than is the case with weak currents. A further means for this purpose is found also in the arrangement of a spring between the two moving parts which are disengaged at one time and engaged at others—namely, the brake and the coil, as represented in Figs. 3 and 4. According to Figs. 3 and 4 the carrier is not fixed, as in Figs. 1 and 2, to the frame 8—*i. e.*, connected with the coil 9—but in this case it is elastic. The inner end of a spiral spring 22 concentrically arranged around the spindle 1 is fastened to the frame 8, while the other end 23 engages by means of a hook or catch with the teeth of the ratchet-wheel 24, being involved in the movement of the said ratchet-wheel whenever it moves to the right, together with the spindle and damper-disk 2, while it freely slides over the wheel during the return movement of the coil 9. For the purpose of securing the effect resulting from the free running described above the ratchet-wheel is provided with but few teeth—say four. The number of teeth is decided on according to the addition effect of the free running and also depends on the magnitude of the angle of oscillation of the coil 9, which may amount to, say, ninety degrees, one hundred and twenty degrees, or more. The effect of the spring 22 is due to the fact that it becomes differently compressed according to the strength of the current before it can involve the brake-disk after engaging the teeth, for with a strong current the spring is more strongly compressed, owing to the electrodynamic force and increased brake-power corresponding to the speed before it can involve the brake, than is the case with a weak current, in which case the retardation is so slight that the spring is not compressed or but slightly compressed, owing to the want of electrodynamic power and brake resistance. This arrangement is therefore similar in effect to the spring of a wattmeter, torsion galvanometer, or the like. By compressing the spiral spring more or less, according to the charge, the spring will allow the coil to pass through a longer or short distance without being damped, resulting in an increase of the oscillatory velocity with the increasing strength of the current. The choice of the spring therefore offers a means for regulating the proportionality.

In all the above cases it is not essential that the registering devices should be actuated by the returning armature 16 of the electromagnet. This effect may also be obtained by means of the brake-disk 2 rotating always in the same direction, thus offering another means of obtaining the registered indications proportionate to the consumption. The circuit is represented in Fig. 1. The coil 9 may be arranged parallel to the electromagnet when on its return oscillations, as represented, or it may be short-circuited or put out of circuit.

Having thus particularly described the nature of my invention, I declare that what I claim is—

1. In an electricity-meter the combination with fixed coils, a pressure-coil arranged to oscillate between the said fixed coils and connected with a frame, a brake-disk hung within the said frame, and a pawl-and-ratchet connection between the said frame and brake-disk; of an armature periodically energized and connected with the said frame to return the same to its initial position, substantially as described.

2. In an electricity-meter the combination with fixed coils, a pressure-coil arranged to oscillate between the said fixed coils and connected with a frame, a contact-plate upon the said frame, a brake-disk hung within the frame, and a pawl-and-ratchet connection between the said disk and frame, of an armature hung in proximity to the said frame, a contact-pin upon the said armature arranged to engage the said contact-plate on the frame, and thus close the circuit to energize the said armature and return the said frame to its initial position; substantially as described.

3. In an electricity-meter the combination with fixed coils, a pressure-coil arranged to oscillate between the said fixed coils and connected with a frame, a contact-plate upon the said frame, a brake-disk hung within the frame, damper-magnets arranged to act upon the said brake-disk, and a pawl-and-ratchet connection between the said disk and frame; of an armature hung in proximity to the said frame, a contact-pin on the said armature to engage the said contact-plate on the frame and thus close the circuit to energize the said armature and cause the latter to return the said frame to its initial position; and means for returning the said armature to its initial position, substantially as described.

4. In an electricity-meter, the combination with fixed coils, a pressure-coil hung to oscillate between the said fixed coils, a frame hung in proximity to the said coils, and secured to the said pressure-coil to oscillate therewith, a brake-disk hung to rotate within the said frame, and damper-magnets arranged to act upon the said frame, a pawl-and-ratchet connection between the said brake-disk and the said frame, and a cushion-spring connected with the said frame; of an armature hung in proximity to the said frame and arranged to engage the latter during the forward movement of the said armature, means for periodically closing the circuit to energize the said

armature, and means for returning the said armature to its initial position; substantially as described.

5. In an electricity-meter, the combination with fixed current-coils; a pressure-coil arranged to oscillate within the field of said fixed coils; a brake-drum acted upon by said pressure-coil in one oscillatory direction only; said pressure-coil oscillating automatically in such direction with a velocity corresponding to the current passing through said fixed coils; of an electromagnet arranged to be brought into the circuit and energized thereby adapted to reverse the movement of said pressure-coil, and means for returning the several parts to their initial positions; substantially as described.

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

PAUL EIBIG.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.