(No Model.) 5 Sheets—Sheet 1.

G. KAPP.

ELECTRIC METER.

No. 597,985. Patented Jan. 25, 1898.

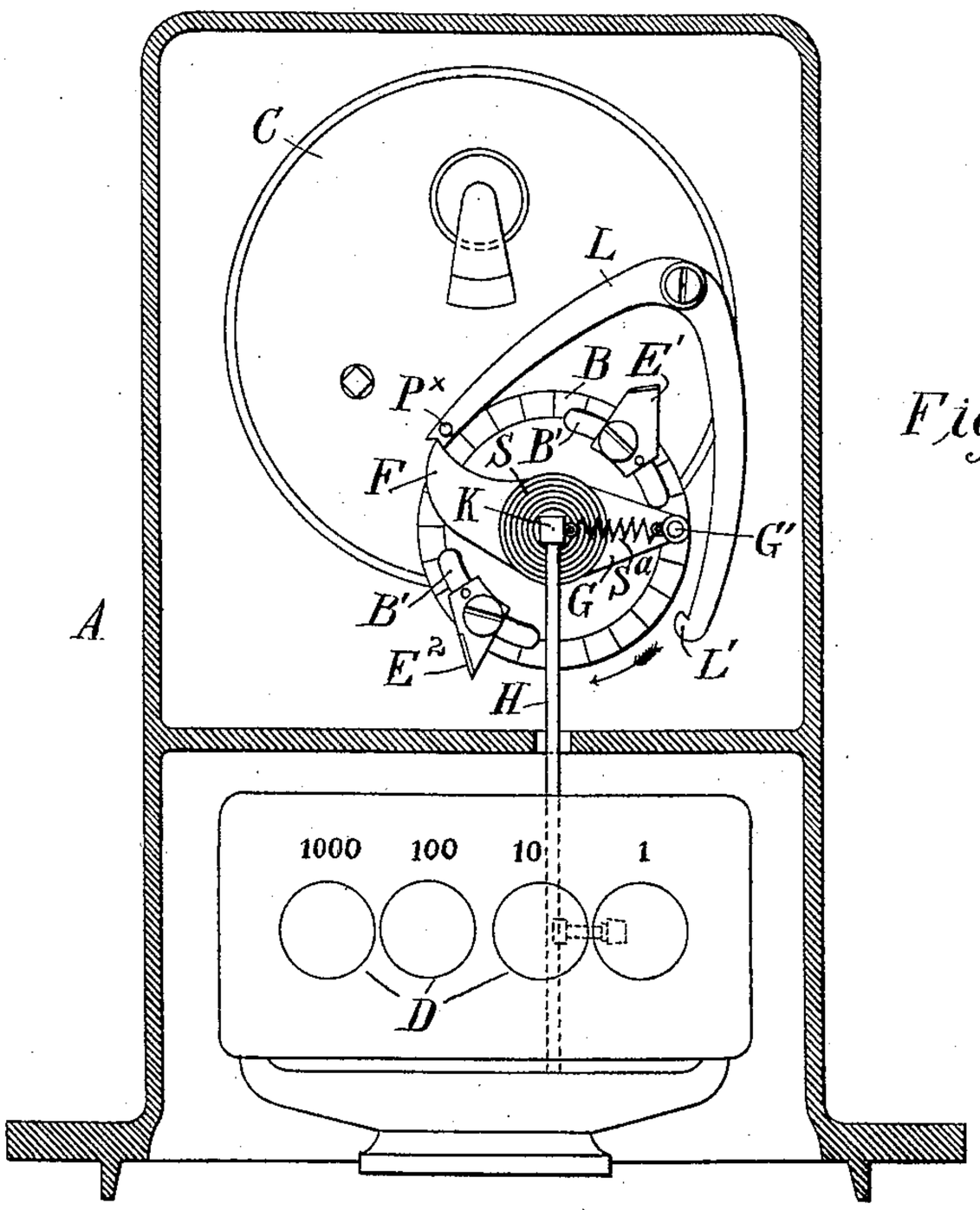
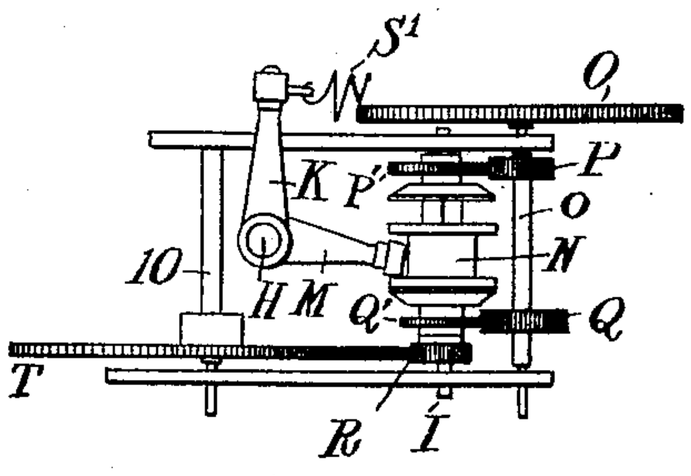


Fig. 1.

Fig. 2.



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By
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Attorney

(No Model.) 5 Sheets—Sheet 2.

G. KAPP.

ELECTRIC METER.

No. 597,985. Patented Jan. 25, 1898.

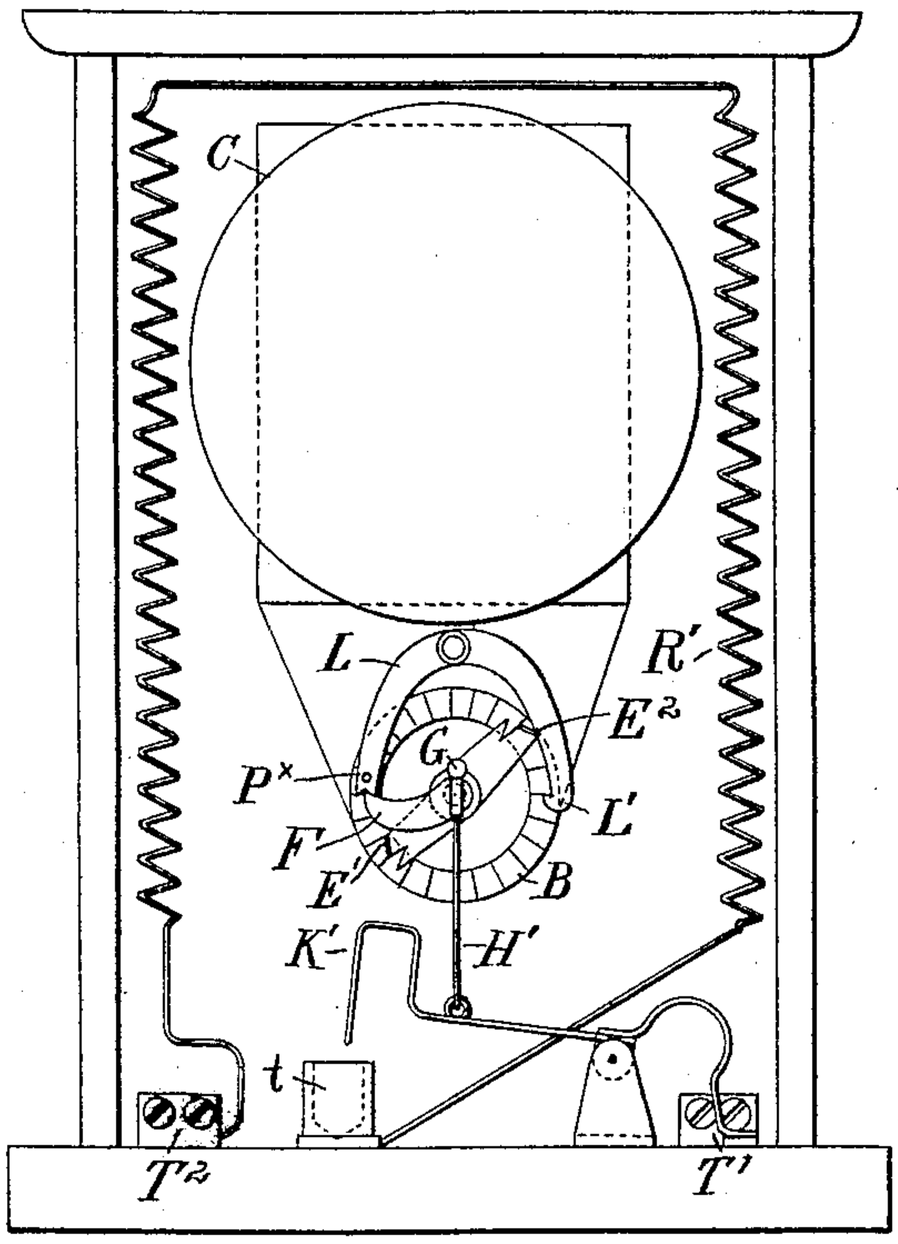
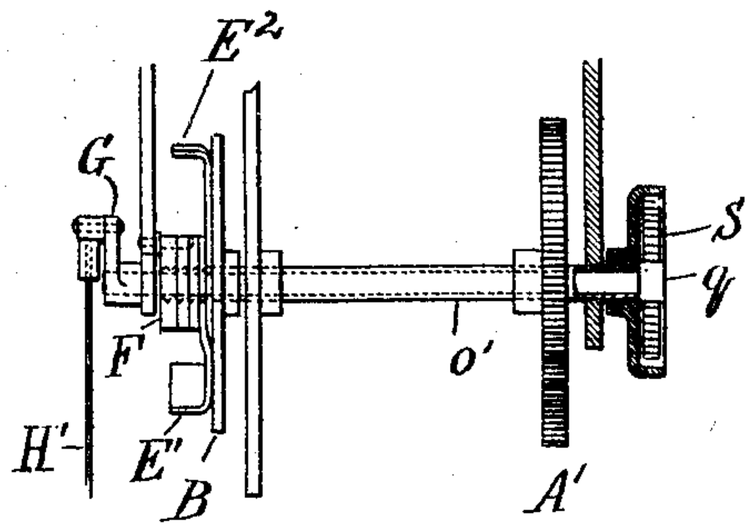


Fig. 3.

Fig. 4.



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(No Model.) 5 Sheets—Sheet 3.

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ELECTRIC METER.

No. 597,985. Patented Jan. 25, 1898.

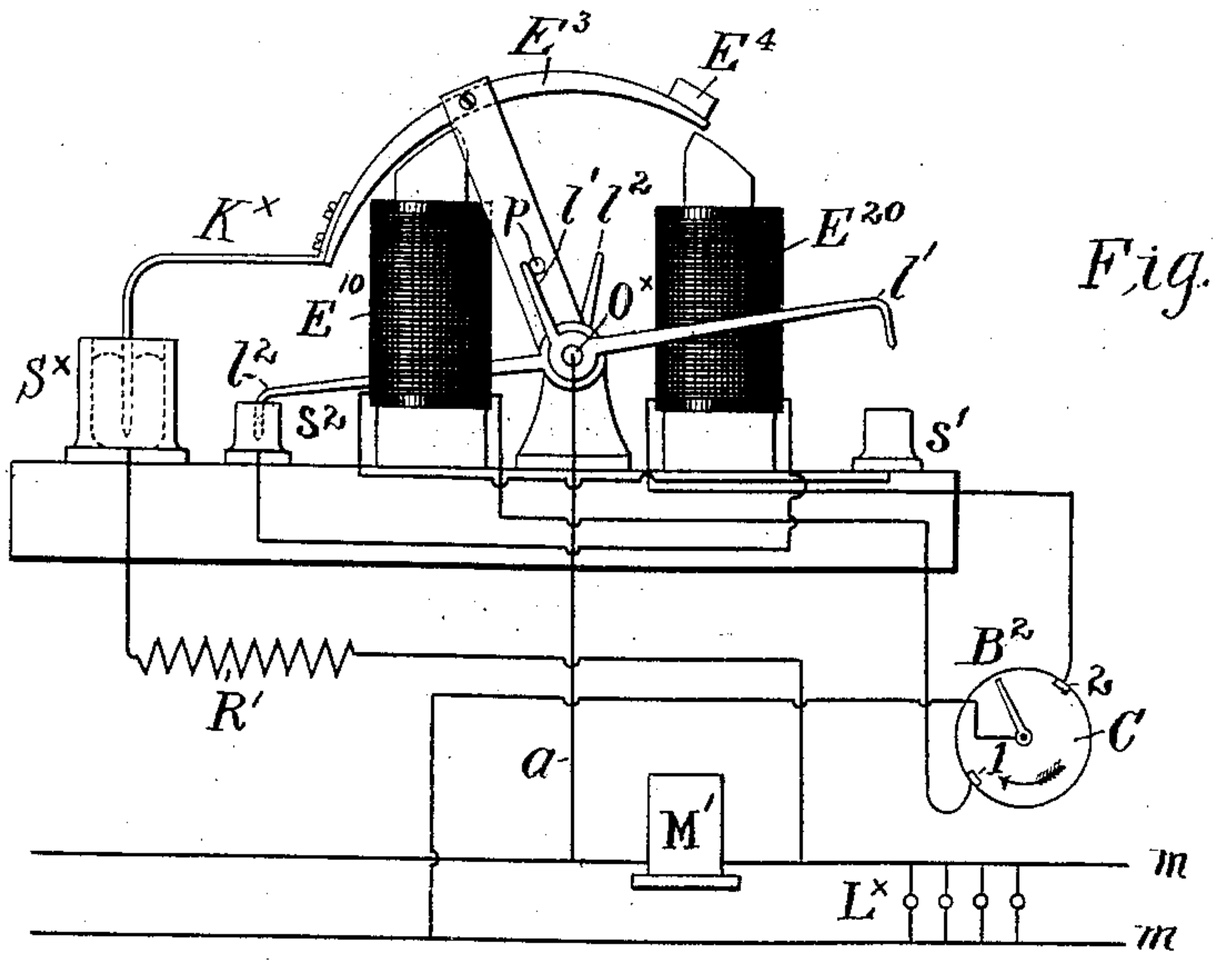

Fig. 5.

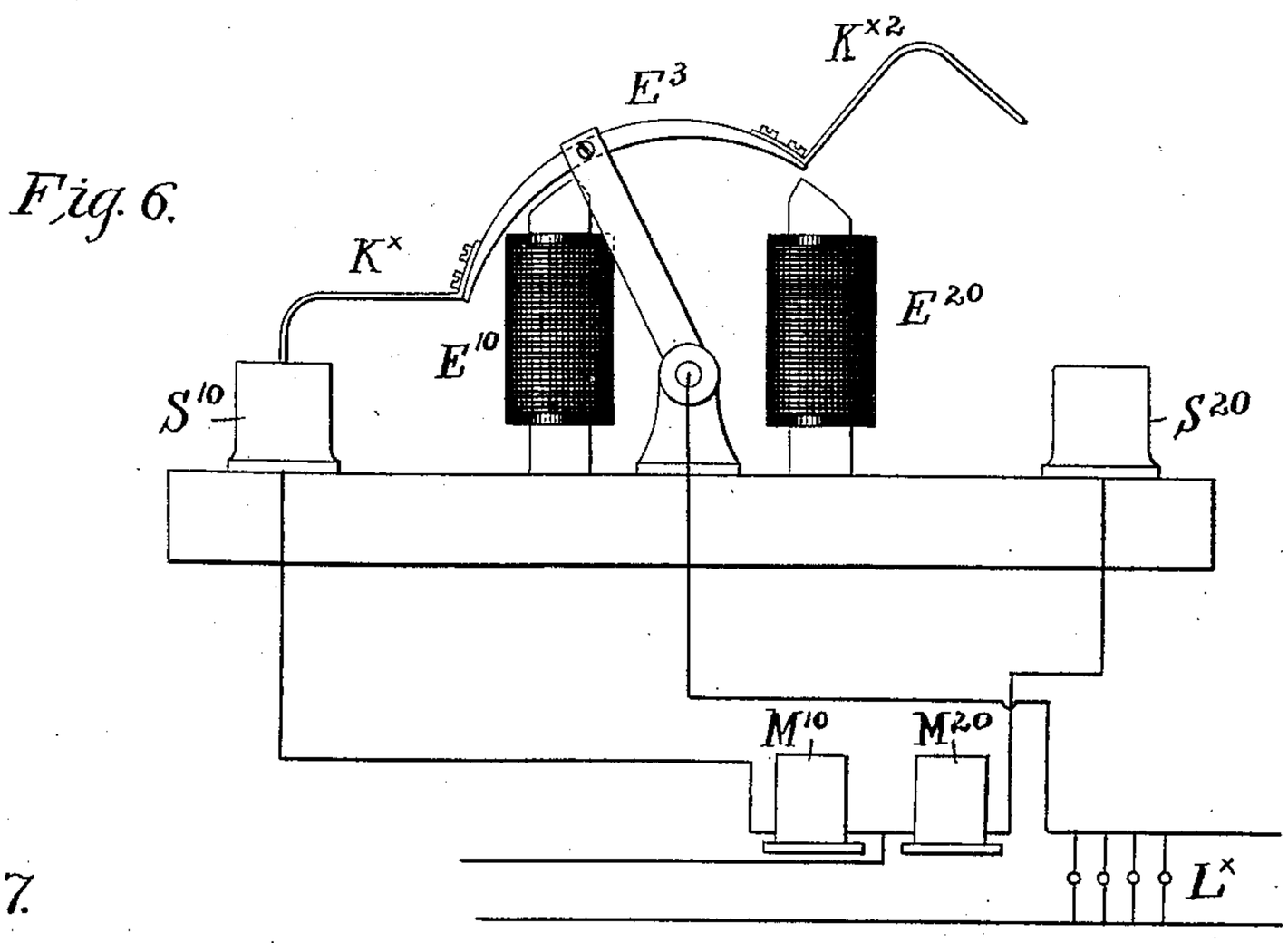

Fig. 6.

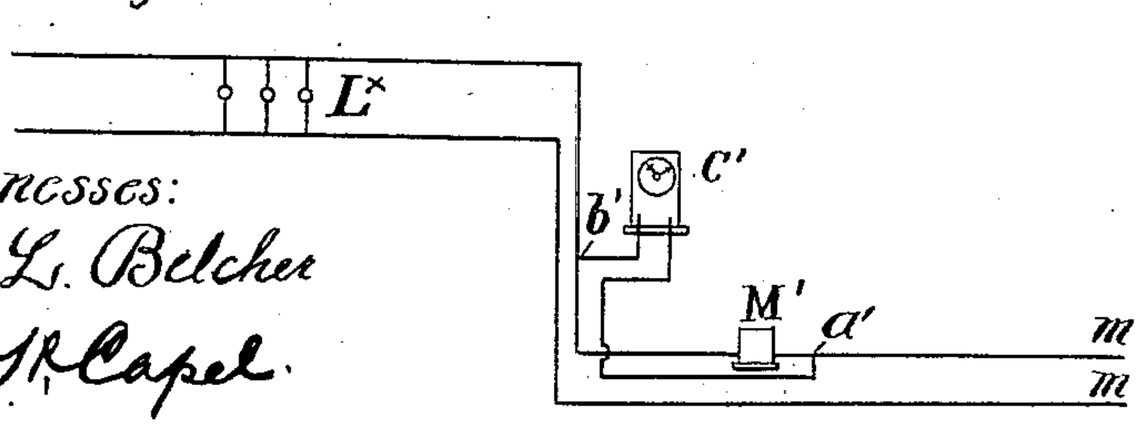

Fig. 7.

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(No Model.) 5 Sheets—Sheet 4.

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ELECTRIC METER.

No. 597,985. Patented Jan. 25, 1898.

Fig. 8.

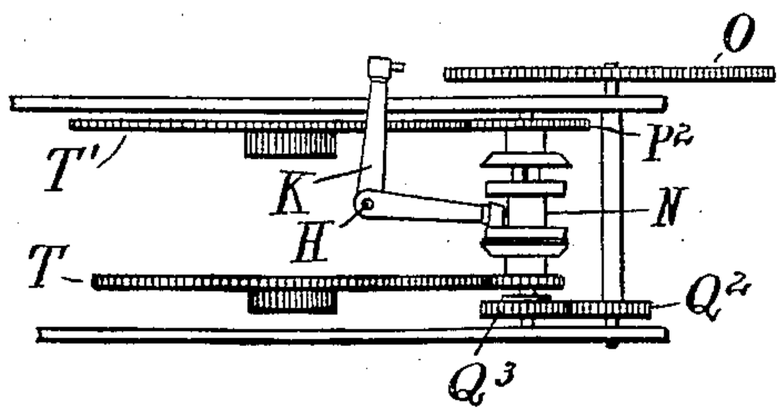
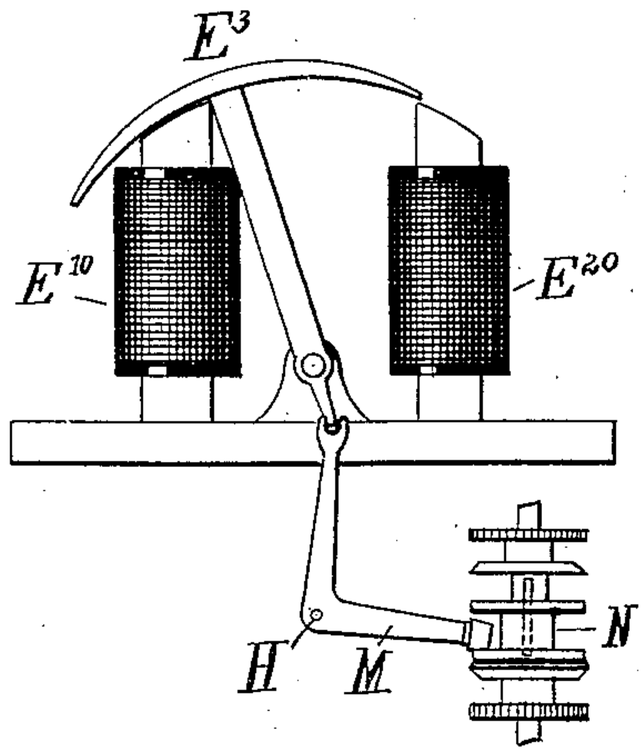


Fig. 9.



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ELECTRIC METER.

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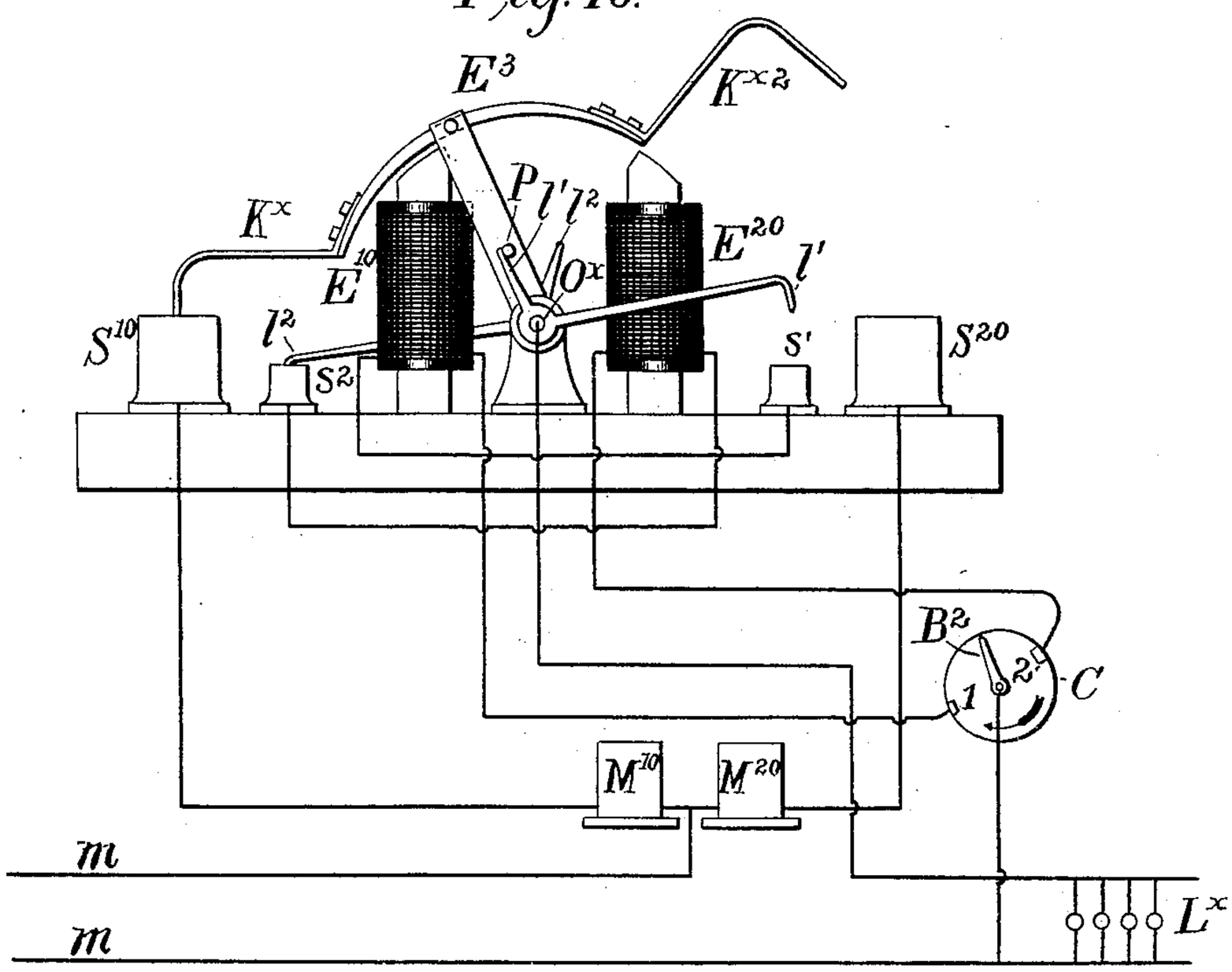
Fig. 10.



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UNITED STATES PATENT OFFICE.

GISBERT KAPP, OF BERLIN, GERMANY, ASSIGNOR TO HENRY C. TOWNSEND, TRUSTEE, OF NEW YORK, N. Y.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 597,985, dated January 25, 1898.

Application filed November 19, 1897. Serial No. 659,145. (No model.) Patented in England April 7, 1892, No. 6,707.

To all whom it may concern:

Be it known that I, GISBERT KAPP, a subject of the Queen of Great Britain, and a resident of Berlin, in the Empire of Germany, have invented a certain new and useful Electric Meter, (for which I have obtained patent in Great Britain, No. 6,707, bearing date April 7, 1892,) of which the following is a specification.

My invention relates to the methods of and apparatus for registering the consumption of an agent, such as electricity, distributed from any point to consumers for the purpose of producing light, power, heat, &c.; and the object of my invention is to provide convenient means whereby the amount of energy consumed during certain hours of the day by individual consumers may be metered or ascertained and charged for separately or at a different rate from that consumed or used at other periods.

Prior to my invention it was customary to make a fixed charge per unit of energy consumed irrespective of the purpose or the particular time of day for which it was required.

My present invention permits the consumption to be metered in such manner that the charge or expense to the consumer may be made or rated differently for different hours of the days, being made smaller or lower during those hours when the demand on the central station is small, thereby enabling and encouraging the consumers to use the agent at such times in preference to times when the demand is larger or for purposes additional to those for which he had before employed it, thus increasing the business and profits of the supply company without requiring additional generating plant.

My invention consists, substantially, of an electricity-meter apparatus having supplemental apparatus or devices, as hereinafter described, combined with suitable mechanism operated or controlled in any desired manner for throwing said supplemental device or apparatus into and out of operation at the beginning and end of certain periods of the day, so as to permit the consumption of energy to be metered or charged for at different rates for different hours of the day. The energy consumed during the period when one rate of charge is made may be recorded or registered on the same dial or device which is used to keep a registry, record, or account of the energy consumed during other hours when another or different rate of charge is made, the registry or record being in such case a total registry of the whole amount consumed, and the amount consumed at different periods being in such case indistinguishable in the record. In this case the supplemental device of my invention is one which operates to change or vary the speed or rate of operation of the meter apparatus for the full and the reduced rate of charge, respectively. If desired, however, the consumption during the period for which the rate is to be changed may be metered upon a supplemental, separate, or independent dial or register or metering apparatus of any character, as hereinafter described, which is thrown into and out of operation at the beginning and end of the period and is actuated or operated at any desired rate of speed. The supplemental apparatus may in this case be a complete meter of any kind or may in the case of a motor-meter be simply a dial or counter combined with proper means for coupling or connecting it with a driving portion of the apparatus, the other dial or register or recorder being preferably cut out of operation at such time.

There are various ways in which I attain these objects. One and the preferred method consists in changing over to and back from the supplemental device or apparatus automatically by means of a clock, one of which is provided for each consumer and is so constructed that it will automatically at the predetermined time set or change over the apparatus of its corresponding meter, so as to properly register or record the energy to be charged for at the different or lesser or reduced rate.

There are various ways in which I may attain this object.

According to one method, which is purely mechanical, the clock is provided with a hand which makes one revolution in twenty-four hours. A pin on this hand engages with a link at the end of the rod attached to a tum-

bling-lever that acts upon a small clutch-coupling on the main shaft of the meter. There are two sets of dials so placed in relation to the main shaft that, according to the position of the coupling, either one or the other set of dials will be in gear, or I may employ only one set of dials and insert between it and the main shaft a counter-shaft with suitable differential gear controlled by the coupling above mentioned. I may also employ, instead of the coupling, a friction-wheel between two parallel disks with their axes parallel, but not in line. The speed ratio between the two disks will depend on the position of the friction-wheel that transmits the motion of one disk to the other. The position of the friction-wheel is controlled by the clock and slotted connecting-rod above mentioned. One of the disks receives motion from the main shaft and the other transmits motion to the counter, and by means of the friction-wheel or any other equivalent mechanical device I am able to vary the speed ratio between counter and meter as may be required to effect the desired change in the speed or rate of operation of the meter apparatus when operating to record the consumption of energy that is to be charged for at a different or reduced rate.

Another method, which is partly mechanical and partly electrical, consists in employing the clock as a relay for sending a current through an electromagnet, solenoid, electromotor, or other electromagnetic device at the proper time and arranging the said device in such a manner that it shall either act mechanically on the gear connecting the meter with the counter, as above explained, or that it shall act electrically by moving a switch connected with the coils or other electrical parts of the meter. In this case the power for working the mechanical gear or the switch is derived from the supply-current, and I may also use the power of the supply-current for making the clock self-winding. For the convenience of the consumer and to show whether the apparatus is in working order I may combine with the meter an index showing at any time the rate at which the meter registers or, if preferred, the charge made at that time per Board of Trade unit.

Where a clock is employed, acting as relay for the operation of a switch, I may use two meters and arrange the switch in such way that it shall send the current either through one or through the other meter, or I may use only one meter and employ the switch to cut out or otherwise affect an operative circuit of the meter. I find it convenient to combine with this switch a second switch so arranged and connected up with the relay-clock as to interrupt the current through the relay immediately the main switch acts.

My object is partly to prevent waste of current through the relay and partly to protect the contacts of the relay from the injurious effects of breaking the current on the relay. By my arrangement the current is made on the relay and broken on the switch.

The accompanying drawings illustrate several examples of apparatus suitable for carrying out my invention.

Figure 1 is a front elevation showing an arrangement of apparatus whereby the rate at which the meter registers is controlled by purely mechanical means, the apparatus being shown in vertical section. Fig. 2 is a plan, to a larger scale, of a part of such apparatus. Fig. 3 shows an arrangement by which the action of the switch is controlled. Fig. 4 is an enlarged side view, partly in section. Fig. 5 shows, diagrammatically, an arrangement in which a relay is used for moving the switch. Fig. 6 shows, diagrammatically, an arrangement which may be adopted when two meters or meter-trains are employed. Fig. 7 shows the general arrangement of apparatus when connected with the wires of a building. Figs. 8 and 9 illustrate that feature of my invention which consists in using the clutch or coupling to connect and disconnect a dial or dials of the meter from the driving-shaft of the apparatus. Fig. 10 is a diagram showing the complete circuits and apparatus embodying the arrangement shown in Fig. 6.

A is a case fitting over the meter and containing the registering-train of dials D of an electric meter and a clock C. The hand or rotary part of the clock, which makes one revolution in twenty-four hours, consists in this arrangement of a disk B, provided with operating or controlling devices, which may consist of pallets $E' E^2$, arranged to strike a pin $P^\times$ on a forked lever L at predetermined times, which depend upon the position of the pallets relatively to the slots B′ in the disks on which the pallets are adjustably fixed by screws, as shown.

F is a finger or trigger connected to a crank-arm G and mounted to turn freely on the twenty-four-hour shaft, but connected with the twenty-four-hour disk by a spiral spring S. As the disk revolves clockwise the spiral spring tends to turn the trigger F also in a clockwise direction, but is prevented from doing so by reason of the tip of the trigger resting against the end of the forked lever L, as shown. At the proper time the pallet E^2 strikes against the pin $P^\times$ and moves it and the forked lever L sufficiently to the left to disengage the trigger, which, impelled by the spiral spring S, then flies around and catches in the projecting nose L′ on the right-hand limb of the forked lever L. The pallet E^2 will have now passed the pin $P^\times$ and the pallet E′ will be approaching it. At the proper time this latter pallet will strike the pin $P^\times$ from the outside and push the forked lever to the right, so as to disengage the trigger from the nose L′ and allow the trigger to fly around into the position shown, in which it will be again caught and arrested by the left-hand limb of the forked lever. The

crank-arm G is thus periodically turned from right to left. To the pin G′ on this crank-arm is attached one end of a spiral spring S, the other end of which is attached by a loose ring to a second crank-arm K, fixed on a vertical spindle H. The spiral spring S acts as a connecting-rod between the two crank-arms G and K.

M is a third crank-arm. It is fixed on the shaft H and engages with a clutch-coupling N, forming part of differential gear with which the train D is provided. This gear comprises a toothed wheel O and a shaft *o*, that receive motion from the meter. To the shaft *o* are fixed toothed wheels P and Q, that transmit motion to toothed wheels P′ and Q′, respectively, which are loose on a shaft I, which is the shaft of the units-dial. As will be seen, the relative sizes of the toothed wheels P Q P′ Q′ are such that the wheel R and shaft I will for a given number of rotations of the shaft *o* make fewer revolutions when driven by the toothed wheels P P′.

R is a toothed wheel fast on the shaft I and gearing with a toothed wheel T on the shaft 10, which in the train corresponds to the dial on which tens of units are shown. The other wheels of the train are not shown, but are arranged as in ordinary counters. The central portion of the shaft I is made square, and on it slides the clutch-coupling N. The arrangement is such that when the clutch-coupling is pressed by the lever-arm M, under the action of the lever-arm G and spring S, against the wheel Q′, as shown in the drawings, the units-shaft I will be revolved from the shaft *o* at the normal rate, depending upon the relative sizes of the toothed wheels Q Q′, and when the clutch-coupling is pressed against the toothed wheel P′ by the reverse movement of the lever-arms G, K, and M, as above explained, the units-shaft will be revolved at another and slower rate, depending upon the relative sizes of the gear-wheels P P′. To reduce friction, I place a small roller on the free end of the lever-arm M, as shown.

I may utilize power derived from the supply-circuit for making the clock self-winding in a manner well understood.

Fig. 3 is a similar view to Fig. 1, showing an arrangement by which the spring and trigger control the movements of a mercury-switch.

Fig. 4 is an enlarged side view, partly in section. C represents the clock, as before. T′ T^2 are the terminals of a mercury-switch K′ and resistance R′, which latter is so adjusted as to shunt a definite proportion of the current past the meter. The meter is not shown in the drawings, but it is to be understood that the terminals T′ T^2 are connected with the terminals of the meter. The twenty-four-hour disk B, forked lever L, with pin $P^\times$ and nose L′, trigger F, lever-arm G, and pallets E′ E^2 are arranged and operate in a similar manner to the corresponding parts in the arrangement hereinbefore described. The spiral spring S also performs the same function as in the previously-described arrangement. It is placed between the solid shaft *q* and a hollow shaft *o*′, Fig. 4. The wheel A′, which receives motion from the clock C, is fast on the shaft *o*′. The disk B is also fast on this shaft. The trigger F and the lever-arm G are fast on the solid shaft *q*. The lever-arm G is connected by a rod H′ with the pivoted switch-lever K′, the free end of which when depressed dips into a mercury-terminal *t*. In the position shown the switch K′ is open and the meter registers at or for the full rate and price. When the pallet E′ strikes the pin $P^\times$, the trigger F flies over to the right and the lever-arm G makes a half-revolution and depresses the switch-lever, whereby a definite proportion of current is shunted through the resistance R′ and the meter registers at or for the lower rate and price.

Fig. 5 shows diagrammatically an arrangement in which a relay is used for moving the switch. *m m* are the supply-mains, and $L^\times$ are the lamps or other devices supplied with current therefrom. M′ is the meter. C is a clock with a twenty-four-hour hand B^2, adapted to make contact at predetermined hours with the contact-pieces 1 2. E^{10} and E^{20} are electromagnets, and E^3 is an armature arranged as a tumbling-lever, pivoted at $O^\times$. The arm of this lever carries two pins *p*, one at each side, these pins being arranged to engage alternately with the short arms of bell-crank levers *l*′ *l*′ and l^2 l^2, respectively. The long arms of these levers dip when depressed into mercury-cups *s*′ and s^2, respectively. $S^\times$ is a large mercury-cup for the main switch $K^\times$. E^4 is a balance-weight for K. The various circuits and connections are clearly shown in the diagram. When the apparatus is in the position shown, a definite proportion of the current passes through *a*, E^3, $K^\times$, $S^\times$, and R′, being shunted around the meter, so that the meter registers at the reduced rate. When the hand B′ arrives at the contact 2, a relay-current is sent through the electromagnet E^{20} and the armature E^3 is thrown over to the right. This opens the switch $K^\times$, and the meter registers now at the full rate and price. As the armature tumbles over the pin *p* at the back strikes the short arm of the lever l^2 and thus breaks the relay-circuit at the mercury-cup s^2. At the same time the long arm of the lever *l*′ is allowed to dip into its mercury-cup *s*′, ready for the next operation when the clock-hand B′ arrives at the contact 1, when a relay-current will be sent through the electrogmagnet E, whereby the switch $K^\times$ and lever l^2 will be again moved back into the positions shown and the meter will again register at the reduced rate. By this arrangement it will be seen that the relay-current is cut off immediately after the main switch $K^\times$ has been thrown over, so that the contact for the relay-current is made by the clock-hand and broken by the relay-switches *l*′ *l*′ l^2 l^2 alternately.

Fig. 6 shows diagrammatically an arrangement that may be adopted when the consumption for certain hours of the day is registered upon a separate meter or meters dial. In this case two complete meters or operating devices are supposed to be employed, although, as before stated, one main shaft, two dials, and a coupling may be employed. M^{10} and M^{20} indicate the two meters, one of which may register the consumption of energy during those hours when the charge is made at one rate and the other when the charge is made at a different rate. S^{10} S^{20} indicate the corresponding mercury-cups. The relay circuits and connections are not shown in the diagram, but are similar to those shown in Fig. 5. To avoid sparking and interruption of current during the operation of switching over, I arrange the mercury-cups and switch-levers in such wise that one contact is made before the other is broken.

In Figs. 8 and 9 the coupling is shown as applied to connect the gear of a supplemental dial or counter with a driving-shaft of the apparatus to register for the consumption of energy to be charged at the special or different rate. The arrangement also permits the gear for the dial or counter which records for the other rate to be thrown out of operation when the first-named dial or counter is thrown in. The initial gear-wheels of the two dials or counters are indicated by the letters T T′, and the coupling slides, as before, on a square shaft which is driven from the gear O by any suitable gear Q^2 Q^3. Fig. 9 shows how the same coupling may be operated by the magnets E^{10} E^{20} and is self-explanatory.

The arrangements hereinbefore described are equally applicable to direct and alternating current supply.

Fig. 7 shows the general arrangement of my apparatus in relation to the installation of electric wires in a building. *m m* are the supply-mains, and M′ is the meter, which may be placed in any desired position. My apparatus may be placed close to the meter, but may also be placed in any other and more convenient position. In the diagram I have shown it at C′. I connect it with the mains at the points *a′* and *b′*. My object of connecting it in the way indicated is to eliminate any disturbing effect which might otherwise be caused by the resistance of the circuits. $L^{\times}$ are the lamps or other apparatus supplied with current from the mains.

That form of my invention in which all of the energy consumed is registered or recorded by the same dial, counter, or recorder, and the speed or rate of operation of the meter apparatus is changed by any supplemental device as by a differential or changeable-speed gear or by means for varying the electrical action of the meter, as also the combination with the disk or wheel of the controlling-clock of operating or controlling devices independently adjustable in position thereon to vary the period of altered operation of the metering apparatus, I do not herein specifically claim, as they form the subject of claims in another application for patent filed by me December 31, 1897, Serial No. 665,123, (Case B.)

That form of my invention which comprises the separate dials or counters combined with a coupling or device for bringing them into and out of operative connection with a driving-shaft is not herein specifically claimed, as it forms the subject of specific claims in another application for patent filed by me December 31, 1897, Serial No. 665,122, (Case A.)

What I claim is—

1. In an electricity-meter apparatus, a supplemental apparatus or device for permitting the consumption of energy to be metered or charged for at different rates for different hours of the day, and means for throwing the same into and out of operation.

2. In an electricity-meter apparatus, a supplemental device or apparatus for permitting the consumption of energy to be metered or charged for at different rates for different hours of the day, and means controlled by a clock, for throwing the same into and out of operation.

3. In an electricity-meter apparatus the combination with two sets of devices for registering the consumption of energy, of means for throwing either one of said sets into and out of operation to provide a separate or distinct registry of the consumption of energy during certain hours of the day.

4. An electricity-measuring apparatus having supplemental means adapted to give a separate registry or record of the consumption of energy during any desired period of the day, and means for throwing the same into and out of operation, whereby a registry of the current consumed during certain hours independent or distinct from that of other hours may be kept.

5. In electric metering apparatus a meter or meter-train combined with mechanism controlled by a clock for automatically bringing said meter or train into and out of action at predetermined times during the day.

6. The combination with a clock, and a magnetically-operated switch the circuits of whose operating-magnets are controlled by the clock, of a second switch in the circuit of the operating-magnet for interrupting the circuit thereof independently of the clock circuit-closer as soon as the switch is thrown.

7. In an electricity-meter apparatus, a separate meter or portion of meter, a controlling-clock, and mechanism governed thereby for throwing said separate meter or portion of meter into and out of operation so as to give a separate or distinct registry during predetermined hours.

8. An electricity-meter apparatus having supplemental means for registering the consumption of electric energy, combined with mechanism controlled by a clock for causing

the same to register the current consumed during predetermined hours.

9. An electricity-measuring apparatus having supplemental means adapted to give a separate registry or record of the consumption of energy during any desired period of the day, and electromagnetically-operated means for throwing the same into and out of operation whereby a registry of the current consumed during certain hours independent or distinct from that of other hours may be kept.

Signed at Berlin, in the Kingdom of Prussia, Empire of Germany, this 27th day of October, A. D. 1897.

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