(No Model.) 2 Sheets—Sheet 1.

F. A. BROCQ.

ELECTRICITY COUNTER.

No. 523,566. Patented July 24, 1894.

Fig. 1.

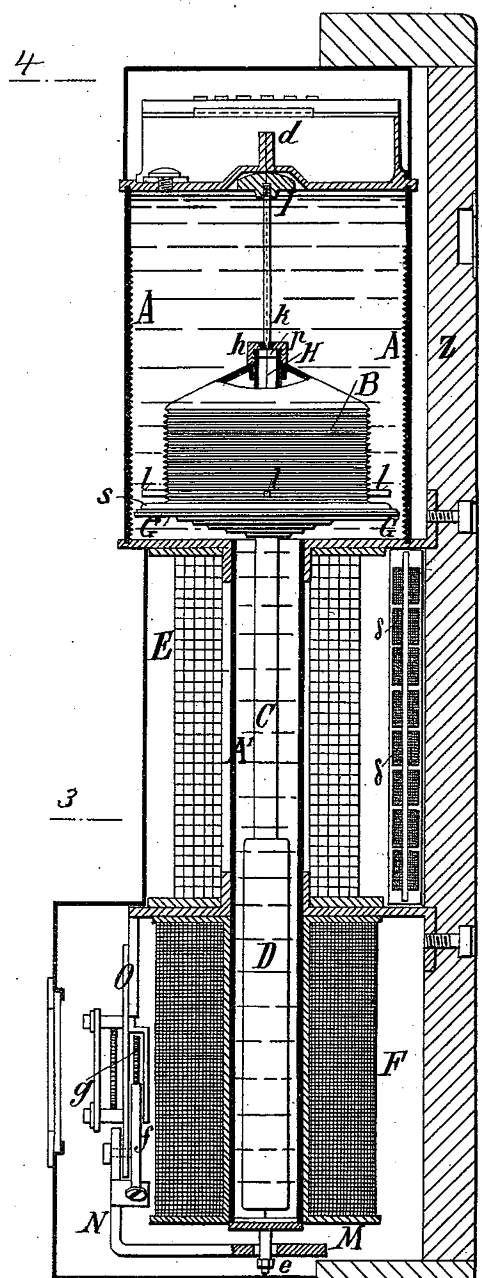
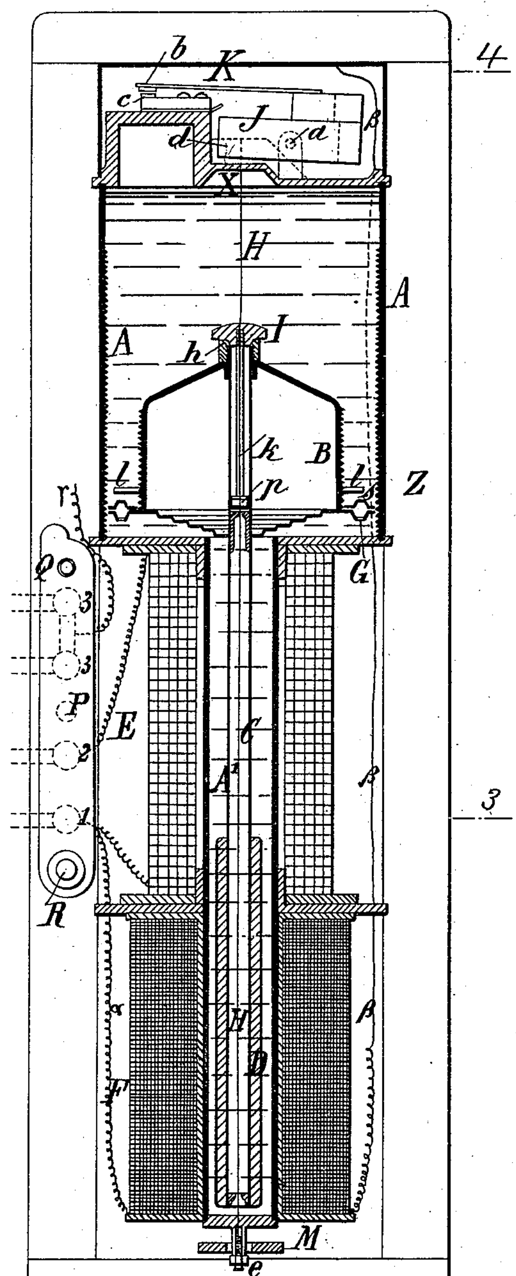


Fig. 2.



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C. K. Fraser.

INVENTOR:

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Arthur C. Fraser & Co.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 3

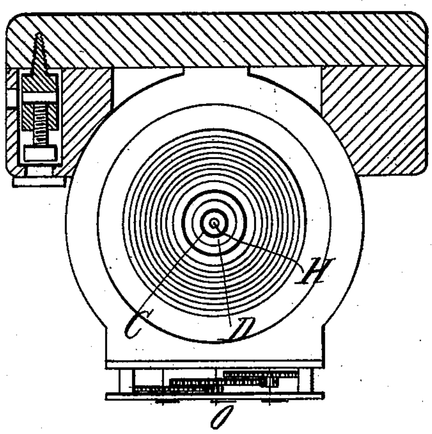


Fig. 4

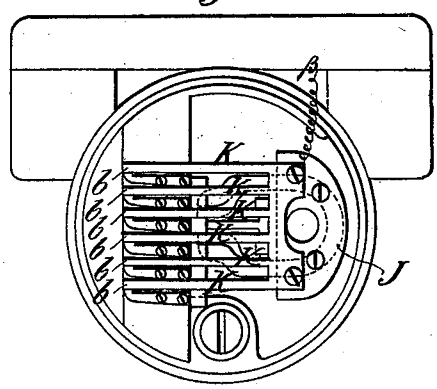


Fig. 5

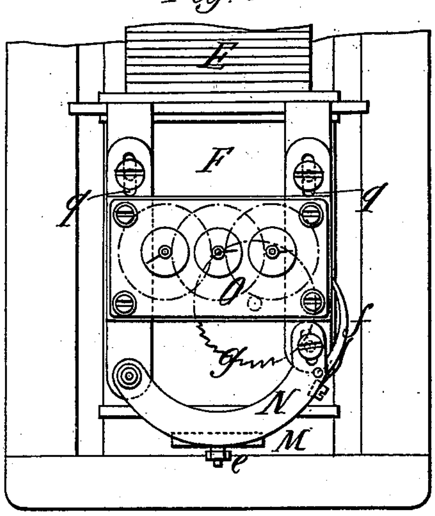


Fig. 6

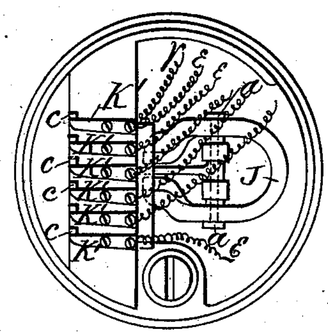


Fig. 7

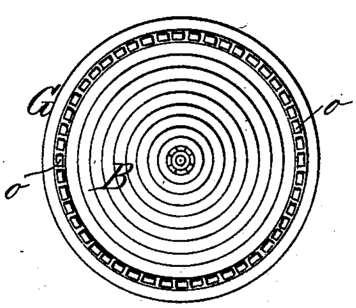
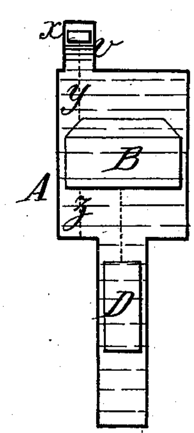


Fig. 8



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FRANÇOIS ALEXANDRE BROCQ, OF PARIS, FRANCE.

ELECTRICITY-COUNTER.

SPECIFICATION forming part of Letters Patent No. 523,566, dated July 24, 1894.

Application filed September 21, 1893. Serial No. 486,053. (No model.) Patented in France June 20, 1891, No. 214,327.

To all whom it may concern:

Be it known that I, FRANÇOIS ALEXANDRE BROCQ, a citizen of the Republic of France, residing in Paris, France, have invented certain new and useful Improvements in Electricity-Counters, (which invention has been patented in France, No. 214,327, dated June 20, 1891,) of which the following is a specification.

This invention relates to electricity counters or electric meters, and is designed to provide an improved device of this character.

To this end in carrying out my invention, I provide certain features of improvement which will be hereinafter fully set forth.

In the accompanying drawings, which illustrate certain adaptations of my invention, Figure 1 is a vertical axial section of an electric counter constructed according to the preferred form of my invention, the line of section being from front to rear. Fig. 2 is a vertical axial section thereof looking from the front. Fig. 3 is a horizontal section thereof cut on the line 3—3 in Figs. 1 and 2. Fig. 4 is a horizontal section thereof cut on the line 4—4 in Figs. 1 and 2. Fig. 5 is a fragmentary front elevation of the lower end of the apparatus showing the counter mechanism. Fig. 6 is a fragmentary view corresponding to Fig. 4 but showing the contact comb K of the magnet J removed. Fig. 7 is a plan view of the under side of the float B; and Fig. 8 is a diagrammatic view showing a modification.

Referring to the drawings, let A represent the enlarged cylindrical part, and A′ the reduced cylindrical part of a vessel containing liquid, B a float therein, C a tube or rod connected to said float, D a core on said tube, E a solenoid coil in the circuit of the current to be measured, F a solenoid coil in a shunt of said circuit, J a switch controlling said shunt and operated by said float, and O a clock-work for recording the operation of the counter.

The counter consists of a vessel made in two cylindrical parts A A′, one internally roughened, of different diameter, containing a float B externally roughened balanced in liquid contained in the vessel. Through this float passes a tube C having at its lower end an iron, steel or other magnetic core D. On the narrowed part A′ of the cylindrical vessel are wound two coils, the upper one E of large wire traversed by the current to be measured, the lower F of fine wire traversed at proper times by a shunt current between the terminals of the circuit. A wire H soldered in the upper gripper *d* is stretched by a nut *e* at the lower end of the axis of the vessel A A′; it serves as guide to the whole movable system consisting of the float B and core D.

The float B has at its bottom a projecting flange G perforated as shown in plan (seen from below the float) Fig. 7; on this flange is laid free an annular valve *s* of thin metal retained by pins *l* projecting above it. At the top of the float a small cap *h* is screwed on the tube C, on which rests the soft iron button I which is also guided by the wire H. This button I has a stem *k* terminating in a collar *p;* when the float reaches the extreme of its ascent, the button cants the magnet switch J which is pivoted at *a* (see Figs. 2 and 6). The magnet J carries six metal blades K which can make contact at *b* with contact keys *c* of the six contacts K′ to send a shunt current through the coil F. In Fig. 6 the comb of blades K is supposed to be removed. At the lower part of the apparatus below the core G there is a pallet M having an arm N carrying a pawl *f* to act upon the ratchet wheel *g*, which drives the counter or clockwork O.

The apparatus is quite closed in, the movements being made magnetically through the walls. It is fixed against a piece of wood Z which can be hung on a wall by a catch hole Y; the screw P (Fig. 2) fixes it in a vertical position. The connecting posts for the currents 1, 2, 3, 3, are fixed at the inside of the wood; the posts 1, 2 are the ends of the coil E and receive, the one a wire of the station, the other a wire of the subscriber; the double post 3, 3, receives the two other conductors. The coil F and the interrupter K K′ are in shunt between 1 and 3, 3.

The complete counter is entirely closed and sealed, and does not require to be opened to be put in place, which allows stamping. A plate Q which can turn on pivot R (Fig. 2) and can be leaded at Q covers at once the posts and the fixing screw.

The counter once placed is protected by a lead seal.

The apparatus operates in the following manner:—Assuming the float B to be down and the little cap I (Fig. 2) also down, the core D carried by the hollow rod C is at the lower part of the compartment A′. If a current of intensity I then traverses the coil E, the core D will be attracted to the middle of the coil E and will ascend subject to a force of the form $k\,I^2$. This force will produce above and below the flange G a difference of pressure H proportional to $k\,I^2$ say $n\,k\,I^2$. The velocity V of ascent will be proportional to the rapidity of flow of the liquid through the annular passage left free between the edge of G and the cylinder A. This rapidity of flow may be represented as $v=k'\sqrt{nkI^2}=K\,I$. The speed of ascent is consequently proportional to I. If l be the stroke and t the time of an ascent, then $t=\frac{l}{v}$. When the float reaches the end of its upstroke, it rapidly descends again as we shall presently see, then it reascends and so on successively. The pawl f and ratchet g register the number of strokes. It will be seen then that if the current has lasted a time T the number N of the ratchet teeth moved will be $N=\frac{T}{t}=\frac{Tv}{l}=\frac{KI}{l}T$. The counter is therefore a Coulomb meter. When the float B reaches its upward extreme, the soft iron cap I carried by it butts against the thin capsule X; it attracts the magnet J making it cant and make contact at K K′. A circuit is thus closed from the post l, wire a, coil F, wire β which connects to the comb K, this comb, the contacts c to which is connected the wire γ which leads to 3, 3. Thus a shunt current is sent through F, the float is powerfully attracted downward leaving the button I up (see Fig. 1). As the resistance of the liquid is relieved by the rising of the annular valve s, the float descends with such rapidity that the time of its descent or its variations may be neglected in relation to the time of ascent with the maximum of supply. At the same time the iron pallet M of the arm N is attracted upward and by the pawl f effects registration of a stroke on the dial of the clockwork. When the float reaches the lower end of its stroke, the collar p at the lower end of the stem k causes the button I to fall, the magnet J then rises, the current through F ceases and the pallet M falls again. The float begins to ascend to produce a like sequence of movements.

The effect of variation of temperature on the balance of the float is compensated as follows:—The lower face of the float is corrugated (see Figs. 1, 2, and 7) so as to have certain elasticity, and it contains a gas or a volatile liquid so selected that the increase of internal pressure is greater than that of the external pressure; it follows that when the density of the liquid is lessened by rise of temperature, the volume of the float increases, and with properly chosen materials the balance is constant within given limits of temperature.

As shown by the diagram Fig. 8 the float B may have attached to it and to a small auxiliary float x two small chains y z having the same weight per unit of length. It is obvious that in the first place the equilibrium of this system is the same for all positions of the float, and farther, that the diameter of the chimney v may be so determined that the float x ascends in it discharging the float B of a quantity equal to the lessening of the push owing to expansion of the liquid.

Another important precaution relates to the suppression of sparking at the contacts K K′. These contacts are six in number and are made in succession. Between them are introduced increasing resistances 8 8 see Fig. 1 without self-induction, for instance of carbon or of wires properly coiled. The resistances are connected to the six contacts K′ by six wires E E. The energy which would produce a spark at each break is then employed to produce current in the next resistance, and the final break is made on a resistance without self-induction as great as may be desired since all the resistances are then in series. Further, in order to annul the effects of friction in registering small amounts, I leave to the float a certain power to ascend, and to avoid the zero mark which would result from that, I regulate the level of the liquid so that there is no action of the external magnet except when there is a certain current as a current of 0.15 ampères to 0.2 ampères for instance. The mark of nothing may also be avoided by the attraction which takes place between the iron of the float which has always some residual magnetism and the pallet M which operates the clockwork; in order to regulate this action the clockwork is fixed to the frame by slotted holes q so that it can be raised or lowered to vary the distance between M and D.

The results of the arrangements adopted are as follows:—They conduce to simple and inexpensive construction of apparatus, occasioning no expenditure of electricity except during the time of illumination, capable of being stamped since it can be conveyed and placed without having to touch any internal parts, and it is entirely inclosed.

My improved counter can be employed as an hour counter if desired.

I avoid variations of the speed of flow of the liquid due to changes of its temperature by the following arrangement:—The interior wall of the cylinder A and the exterior wall of the float B are provided with sharp grooves or projections which render the surfaces rough or irregular, whereby they are able to retain in repose the liquid which is in contact with them during its movement. One may therefore say there is not any appreciable movement of the liquid against the metal walls, but rather a movement of the liquid on itself, and the friction due to this cause is almost invariable, no matter what the temperature may be.

I claim—

1. In a counter for measuring an electric current, a vessel containing liquid, in combination with a float in said vessel, a core connected to said float for operating it, a magnetic coil in the circuit of the current to be measured acting magnetically on said core to operate it, a switch operated by said float when the core of the latter is moved by said coil, means for restoring said float to the initial position when it has operated said switch, and a counter for recording the movements of said float, all substantially as and for the purpose set forth.

2. In a counter for electricity, a vessel containing liquid, in combination with a float in said vessel, a core carried by said float, a magnetic coil in the line of the current to be measured and actuating magnetically said core and thereby moving said float, a valve controlling the movement of said float within the liquid in said vessel, means for restoring said float to its initial position after movement, and a counter for recording the movements of said float, all substantially as and for the purpose set forth.

3. In a counter for electricity, a vessel containing liquid, in combination with an electrically controlled float in said liquid, the movement of which float serves to record the intensity of the current to be measured, said float expanding with variations in temperature, whereby its balance is maintained at all times, substantially as and for the purpose set forth.

4. In a counter for measuring electricity, a vessel containing liquid, and having internal roughened walls, in combination with an electrically actuated float within the liquid of said vessel, said float having external roughened walls, whereby during the movement of the float within the vessel the liquid therein is caught in the roughened portions of the walls of said parts and its rapid flow across these walls is prevented.

5. In a counter for measuring electricity, a vessel A A′ containing liquid, in combination with a float B within said vessel, a tube C carried by said float, a core D connected to said tube, a magnetic coil E in the circuit of the current to be measured and acting magnetically on said core D to lift said float, a magnet coil F in the shunt of the circuit of the current to be measured and acting magnetically on said core D, and a switch in the shunt of said coil F and closed by the movement of said float under the action of said coil E, and opened by the movement of said float under the action of said coil F, and a counter recording the movements of said float, all substantially as and for the purpose set forth.

6. In a counter for measuring electricity, a magnetic coil E in the circuit of the current to be measured, and a core D moved by said coil, in combination with a shunt in the circuit of the current to be measured, a switch in said shunt, a permanent magnet movably mounted and when moved operating said switch, and a movable armature controlling the operation of said magnet and moved into the magnetic field thereof by the movement of said core, substantially as and for the purpose set forth.

7. In an electricity counter, a magnetic coil E in the circuit of the current to be measured, a core D moved by said magnet, a shunt in said circuit, a coil F in said shunt and acting on said core, a switch J in said shunt and consisting of a permanent magnet and a metal contact blade carried thereby, an armature I for said permanent magnet connected to said core by a movable connection and moved by said core into the magnetic field of said magnet to operate the latter, and a guide for said core, substantially as and for the purpose set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

FRANÇOIS ALEXANDRE BROCQ.

Witnesses:

JULES ARMENGAUD, Jeune,

CLYDE SHROPSHIRE.