(No Model.)

# G. HUMMEL.

## COULOMB COUNTER.

No. 491,560. Patented Feb. 14, 1893.

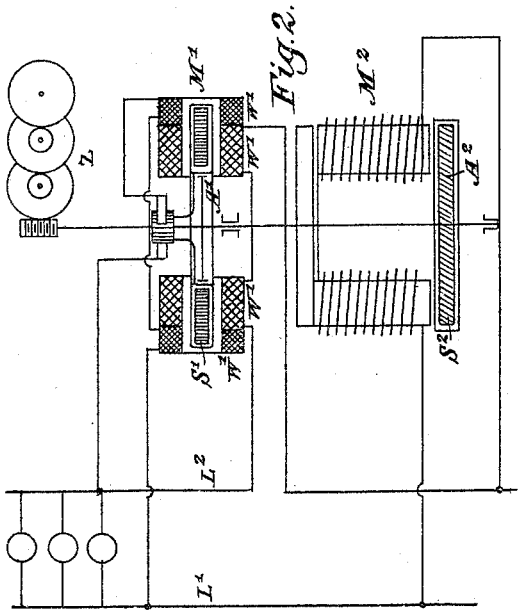

Fig. 2.

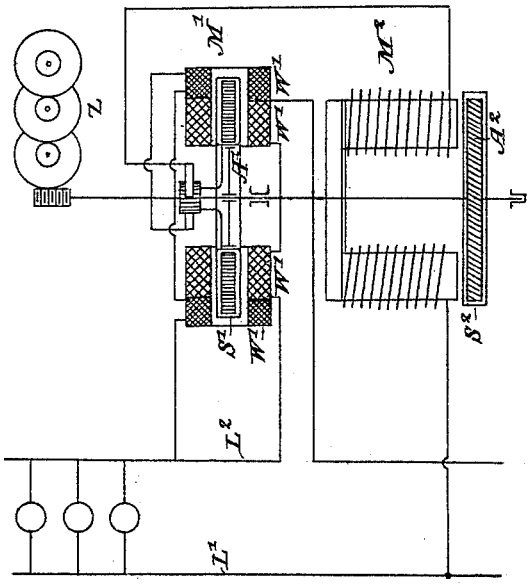

Fig. 3.

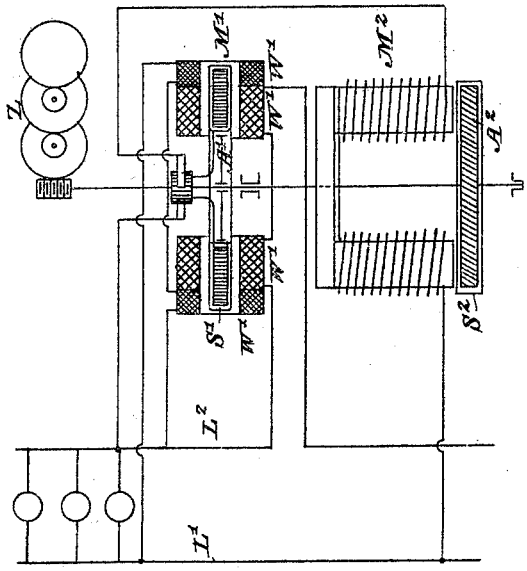

Fig. 1.

WITNESSES:

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# UNITED STATES PATENT OFFICE.

GEORG HUMMEL, OF NUREMBERG, GERMANY.

## COULOMB-COUNTER.

SPECIFICATION forming part of Letters Patent No. 491,560, dated February 14, 1893.

Application filed February 16, 1891. Serial No. 381,645. (No model.) Patented in Germany September 20, 1887, No. 43,487.

*To all whom it may concern:*

Be it known that I, GEORG HUMMEL, a subject of the King of Bavaria, and a resident of Nuremberg, Germany, have invented certain new and useful Improvements in Coulomb-Counters, (patented in Germany September 20, 1887, No. 43,487,) of which I do hereby declare the following to be a full, clear, and exact description.

The herein-described electric meter is based upon the principle of mutual dynamic action between a fixed and movable electric conductor.

In accompanying drawings forming part of this specification, Figure 1 is a diagram view showing the arrangement of the different parts and connections of the apparatus, and Figs. 2 and 3 are modifications thereof.

Referring to the drawings M′ designates an electric motor. The armature A′ may be of any suitable construction, as, for instance, a Pacinotti ring, a Hefner-Alteneck drum, &c. The iron core of said armature is constructed in a well-known manner to avoid noxious currents as much as possible, and is surrounded by the induced coils S′, the terminals of which are connected with any suitable source of electricity of as constant a potential as possible, such for instance with the main conductors, L′ $L^2$, of current consuming apparatus arranged in parallel circuit. The said armature is influenced by stationary inducing solenoids, W′, which are switched into the circuit, the current of which is to be measured with or without shunt. In addition to the solenoids W′, the solenoids $w'$ may be used, the terminals of which are also connected with the source of current having its potential as constant as possible (see L′, $L^2$). The object of these last-mentioned solenoids is to exert a tractive power on the ring capable of overcoming all mechanical resistances. Both sets of solenoids, W′ $w'$, preferably have no iron so as to avoid errors usually resulting in such apparatus and due to the varying magnetism in iron bodies.

Mounted on and revolving with an extension of the shaft of the armature A′ is a disk or cylinder of good conducting material. It is not necessary, however, that said disk or cylinder should be directly coupled with the armature shaft as it is quite evident that it will serve as well to provide a parallel or counter motion through the medium of belt or other gearing. This disk, or drum, exerts a dampening or retarding effect upon the rotating movement of the armature A′ by virtue of the fact that said disk, or drum, revolves in a constant magnetic field induced through the agency of the cores $M^2$, the coils of which connect with the main circuit wires L′ $L^2$ either directly, as shown in Fig. 2, or through the armature and solenoids of the first motor M′, as shown in Figs. 1 and 3. By means of this arrangement, the revolution of the motor M′ and magnetic disk will be proportional to the current to be measured within very wide limits.

To illustrate the operation of the apparatus by an equation, the following explanation should be taken into consideration: The energy developed by the motor M′ is (apart from the mechanical resistance which as before stated is compensated for by the outer solenoids $w'$) proportional to the inducing current strength J to be measured and to the velocity $v$. It is absorbed by the currents generated within the copper disk, the capacity of work of which currents being proportional to the square of the velocity $v$. The following equation is, therefore, secured: $Jv=v^2K$, or $J=Kv$ K indicating one of the constants depending on the construction of the apparatus. It must be understood, however, that the foregoing explanation is based upon the assumption that the strength of the current in the coils of the armature A′ remains constant.

In the arrangement of circuits shown in Fig. 1, however, this is not the case because when the armature A′ rotates, an electro-motive counter force is exerted which is proportional to the velocity $v$.

By means of the construction described and illustrated any variations in the strength of the current will influence the motor M′ as well as the magnetic field induced by the cores $M^2$, and will, consequently, not result in any perceptible variation in the velocity. A modification of an arrangement providing for this consists in switching the coils $w'$ into circuit with the coils of the cores $M^2$ or the armature A′ or into the common circuit of the armature of motor M′ and of the coils of the cores $M^2$

(see Figs. 2 and 3). The armature shaft is connected to or in gear with a suitable counter Z, which, by registering the revolutions of the same, enables the quantity of the current used to be readily determined.

I claim:

1. In a registering meter for electric current the combination of an electric motor the stationary coils of which forming the field magnet of the said motor are traversed by the current to be measured and the movable coils of which in a shunt circuit form its armature, with a damping device consisting of a disk or cylinder of conducting material driven from the armature shaft, the magnets $M^2$ in the circuit arranged to act upon the damping device, the connection between the damping disk and the armature shaft being positive and non-yielding and the registering device in positive connection with the damping disk substantially as described.

2. In a registering meter for electric current the combination of an electric motor the stationary coils of which forming the field magnet of the said motor are traversed by the current to be measured having no iron in its magnetic field and the movable coils of which in a shunt circuit form its armature, with a damping device consisting of a disk or cylinder of conducting material driven from the armature shaft, the magnets $M^2$ in the circuit arranged to act upon the damping device, the connection between the damping disk and the armature shaft being positive and non-yielding and the registering device in positive connection with the damping disk substantially as described.

3. In a registering meter for electric current the combination of an electric motor the stationary coils of which forming the field magnet of the said motor are traversed by the current to be measured and the movable coils of which in a shunt circuit form its armature, with a damping device consisting of a disk or cylinder of conducting material moving in a constant magnetic field and a supplementary coil joined in series with the armature for the purpose set forth substantially as described.

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

GEORG HUMMEL.

Witnesses:
JOHANN A. CRAHAM,
HERMANN MESTHALER.