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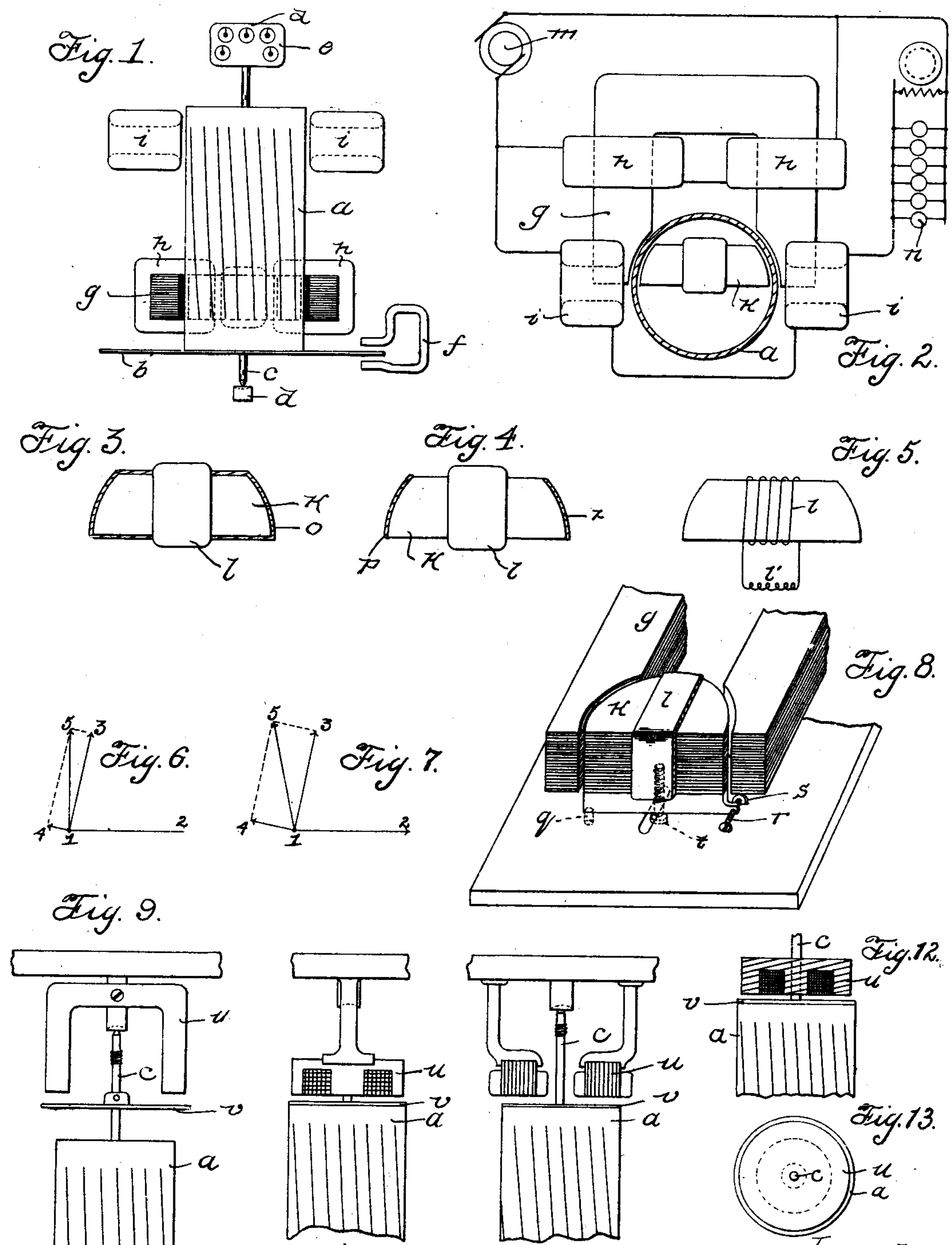
L. GUTMANN.

ELECTRIC METER.

(Application filed June 6, 1900.)

(No Model.)



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UNITED STATES PATENT OFFICE.

LUDWIG GUTMANN, OF PEORIA, ILLINOIS.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 675,996, dated June 11, 1901.

Application filed June 6, 1900. Serial No. 19,282. (No model.)

To all whom it may concern:

Be it known that I, LUDWIG GUTMANN, a citizen of the United States, residing at Peoria, in the county of Peoria and State of Illinois, have invented a certain new and useful Improvement in Electric Motors and Meters, (Case No. 100,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to motors and meters.

The invention in some of its aspects relates to devices of this kind that are operated through the agency of alternating, intermittent, or pulsating currents.

The invention may be employed in connection with integrating, recording, and indicating meters.

Other features of my invention may be adapted for service in connection with meters or motors operable through the agency of any suitable current and are applicable to indicating or recording meters.

One feature of my invention relates particularly to meters for measuring the true watts in a power-circuit. This feature of the invention may be generally described as consisting in improved means for producing a resultant pressure-field that is maintained in quadrature with the impressed electromotive force, this field coacting with a series of current-fields to effect the rotation of an armature inductively associated with these fields to secure motion of the armature proportional to the true watts. This feature of my invention is particularly adaptable to constructions illustrated in Patent No. 614,225, granted to me November 15, 1898, although other applications of the invention may be made. In practicing this feature of my invention I employ a compound magnet system having two physically-distinct cores, one of which is magnetized by a primary current, which in the case of wattmeters traverses the shunt or pressure winding, and the other by a secondary placed about the same, whereby the desired phase relation of the resultant field due to the component fields of the distinct cores is secured with relation to the impressed pressure. This result is secured by means of my invention in a very simple, effective, and accurate manner.

Another feature of my invention consists in magnetic means for reducing the friction to which the rotatable element is subjected, comprising in the preferred embodiment of this feature of the invention a magnetizable portion carried by the rotatable element of a magnet in whose field the said magnetizable portion is placed, whereby the lower bearing of the rotatable element or armature is relieved of the weight of the latter element.

A third feature of my invention consists in an adjusting device for modifying a magnetic field comprising main and supplemental magnetic cores relatively movable with regard to each other, the supplemental core having an eccentric mounting, whereby the adjustment may be rapidly and effectively secured.

I will explain my invention more particularly by reference to the accompanying drawings, illustrating the preferred embodiment thereof as applied to meters.

Figure 1 is a side elevation illustrating the construction of a meter equipped in accordance with the invention. Fig. 2 is a plan view of the structural parts illustrated in Fig. 1, the relation of the instrument to the system of distribution being diagrammatically indicated. Figs. 3, 4, and 5 illustrate modifications of the supplemental core and its secondary winding. Figs. 6 and 7 are vector diagrams illustrating the field-current and pressure phase relations. Fig. 8 is a perspective view illustrating my improved adjusting means for modifying the pressure-field. Figs. 9, 10, 11, and 12 are detailed views of my improved means for relieving the rotatable element or armature of excessive friction, Fig. 11 being a side view of the structure illustrated in Fig. 10, while Fig. 13 is a plan view of the magnet illustrated in Fig. 12. Fig. 13 is a plan view of the magnet entering into the device illustrated in Fig. 12.

Like parts are indicated by similar characters of reference throughout the different figures.

Referring more particularly to Fig. 1, the armature *a* therein illustrated is constructed in accordance with the aforesaid patent granted to me, being preferably provided with a damping-disk b at its lower end, the armature and damping-disk being mounted upon a common spindle c, journaled in upper and lower bearings d d. The armature is preferably cup-shaped, as illustrated.

The instrument shown is a recording-wattmeter, a counting-train e being shown in operative engagement with a spindle or shaft c. Damping-magnet f is in inductive relation to the disk b to properly retard the rotation of the armature. A magnetizable laminated core g is shown in the form of a horseshoe and is located upon the exterior of the armature, this core being provided with a shunt-winding, which constitutes a primary winding and is preferably subdivided into two coils h h, each disposed upon a leg of the core. The shunt core and coils are shown at the lower part of the armature arranged in a plane parallel with the plane of rotation of the armature, the series or current coils i i being located above the shunt-coils and preferably near the top of the armature. Any suitable means may be employed for supporting the coils of the instrument. Where the structure is employed in a meter, the current-coils i i may be unprovided with magnetizable cores. By the arrangement illustrated the windings h and i do not coöperate to produce a rotating field.

The core g forms one part of the compound magnet system. The remaining part or core portion k of this system is contained within the armature and is preferably located in the same plane with the core g and at right angles to the contiguous legs of the latter core. This core portion k not only serves to reduce the magnetic reluctance of the magnetic circuit for the flux due to the shunt-winding, but also serves, in combination with a closed conductor l, to maintain the resultant pressure-field in quadrature with the impressed pressure. The closed conductor l may be in the form of a conducting-band of suitable metal, as copper, or may be in the form of a number of turns of wire, and, as illustrated in Fig. 5, included in a closed circuit with a resistance l'.

As illustrated in Fig. 2, the meter is connected in circuit with a suitable source of alternating current m, supplying translating devices n, which may be either inductive or non-inductive, or both inductive and non-inductive, the meter serving to measure properly the true watts, irrespective of the nature of the load. The current and pressure coils are shown conductively included in circuit, the current-coils being included in one of the mains, while the pressure-coils are in bridge of the mains. By locating the closed conductor upon the supplemental core k a component magnetic field is created that is displaced nearly one hundred and eighty degrees from the impressed electromotive force and from the current when the load is non-inductive, being in quadrature with the current in the shunt-winding.

Referring to the vector diagrams illustrated in Figs. 6 and 7, it will be readily understood in what manner the phase adjustment is secured. The line 1 2 in each figure represents the impressed electromotive force which is in phase with the current when there is a non-inductive load. The line 1 3 represents a component field due to the shunt-winding. The line 1 4 represents the component field due to the supplemental core of the compound magnetic system, while the line 1 5 represents the resultant field, whose phase relation with respect to the electromotive force may be determined.

In Fig. 6 the resultant magnetic field is shown in quadrature with the impressed electromotive force, while in Fig. 7 it is slightly greater than ninety degrees, this adjustment being determined by the resistance in the closed conductor of the supplemental core. I secure this result by making the core portion k separate from the core g, whereby two distinct component fields are produced, one due to the core k and the other to the core g, the core k, which is initially threaded by lines of force from the core g, having additional magnetic flux superimposed upon the initial flux by means of the closed conductor l, whereby the phase of the flux flowing through the core k is modified sufficiently to secure the desired resultant pressure-field. The supplemental core k may be constructed as shown in Fig. 2, where a core of readily-magnetizable laminated iron, homogeneous throughout, is illustrated, or the construction illustrated in Fig. 3 may be employed, where I have illustrated the core inclosed by a conducting-sheathing o. The construction illustrated in Fig. 4 may be employed, if desired, where the pole-faces of the core k are alone provided with metallic-faced plates p. These separately-applied facings of the core k are well adapted for the generation of Foucault currents. These facings supplement the action of the closed secondary conductors about the core k and serve to still further increase the lag between the impressed pressure and the component field due to the core k, as they act in the capacity of closed conductors. To secure this result, these facings are placed transversely to the flux. For specific compensations either the conductor l or the facings p may be alone employed.

The form illustrated in Fig. 5 is well adapted for power-motors.

The operation of the apparatus will now be understood. The magnetic core g is energized by the shunt-winding h, polar regions opposite the armature being established at the ends of the core. Magnetic flux passes through the core k, due to the inductive action of the core g, this core k being subjected to a secondary magnetization due to the closed conductor l. The poles of the inner core face those of the outer core, a difference in phase existing between the poles of the inner core and the poles of the outer core, which serves to secure the desired phase relation between the resultant pressure-field due to these cores *g* and *k* and the impressed pressure, the component fields due to the cores, however, serving in no wise to effect rotation of the armature. This is an important feature of my present invention, as by this means I am enabled to secure the required phase adjustment without causing the armature to rotate on no load, which it would be liable to do if these component fields of displaced phase acted to secure rotation. Any meter that has no automatic compensation is liable to run backward when the power factor of the circuit is low, because in such event the shunt-current will lead, while with non-inductive loads the shunt-current lags behind the series current.

In Fig. 8 I have shown my improved means for effecting the adjustment of the core portion *k*. This core portion is provided with a mounting eccentric to the axis of rotation of the armature, one end being preferably mounted upon a pivot *q*, projecting from the base of the core *k*. The other end of the core *k* is provided with an adjusting-screw *r*, which engages a lug *s*, projecting from the base of the meter, this screw serving to secure delicate adjustment of the core *k* upon its eccentric pivot. A screw *t* is employed to secure the cork *k* in its adjusted position. By this adjusting means I am enabled to readily effect a compensation for friction in the movable parts of the meter, so that the instrument will measure on the slightest load.

I have illustrated in Figs. 9 to 13, inclusive, means constructed in accordance with my invention for reducing the friction to which the armature is subject.

In Fig. 9 I have illustrated a permanent horseshoe-magnet *u*, stationarily disposed, and a magnetizable disk *v*, of iron or steel, carried by the armature and facing the magnet. The pressure or weight of the armature upon its lower bearing is thus decreased.

I am aware that it has heretofore been proposed to overcome armature friction by magnetic means, which in the course of time become weakened and which cause stray magnetic fields, which improperly modify the operation of the meter.

By the construction illustrated in Fig. 9 the magnet is practically close-circuited, whereby its strength is maintained, the disk *v* acting also as a shield that magnetically separates the magnet *u* from the remainder of the instrument.

In Figs. 10 and 11 electromagnets are shown, these magnets acting on the plate or disk *v*. The windings of the magnets may be included in circuit with the shunt-winding *h*. The disk *v* in this instance also acts as a cover to the cylindrical armature.

In Fig. 12 I have shown an electromagnet having a circular winding contained in an annular recess of the core. This magnet may be connected in circuit with a suitable source of current.

I have herein shown and particularly described the invention as applied to alternating-current wattmeters; but I do not wish to be limited to the application of the invention to this class of devices, as the invention may be applied to meters and motors of other construction and possessing other modes of operation; but,

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In an electric motor, the combination with an armature, of a compound magnet system having two distinct cores inductively related to said armature, a primary energizing-winding for one of said cores, a secondary closed conductor about the remaining core, the latter core being unprovided with any primary winding, and means coacting with said magnet system for effecting rotation of the armature, substantially as described.

2. In a wattmeter, the combination with an armature, of a compound magnet system having two distinct cores inductively related to said armature, a primary energizing-winding for one of said cores, a secondary closed conductor about the remaining core, the latter core being unprovided with any primary winding, a current-winding also in inductive relation with the armature, and a measuring element operated by the armature, substantantially as described.

3. In an electric meter, the combination with current and pressure field windings, of a cylindrical armature subjected to the action of the fields due to said windings, a measuring element actuated by said armature, a compound magnet system having two distinct cores arranged in a plane transverse to the axis of rotation of the armature, one of said cores being upon the interior of the armature and the other upon the exterior, one of said cores being associated with the pressure-winding, and a closed conductor for the remaining core, substantially as described.

4. In an electric meter, the combination with current and pressure field windings, of an armature subjected to the action of the fields due to said windings, a measuring element actuated by said armature, a compound magnet system having two distinct cores, the said pressure-winding coöperating with one of said cores to produce one component magnetic field, and means coöperating with the second core for producing a second component field substantially in quadrature with the aforesaid component field, whereby a resultant pressure-field is produced substantially in quadrature with the pressure, substantially as described.

5. In an electric motor, the combination

with a rotary armature, of a primary winding, a secondary winding, a compound magnet system of two distinct cores, one of which is energized by the primary winding, while the second core is exclusively energized by the joint action of the first core and the said secondary winding, and means coacting with said magnet system for effecting rotation of the armature, substantially as described.

6. In an electric meter, the combination with an armature adapted to rotate, of a coreless current-winding, a magnetic core system consisting of two core parts facing said armature, a shunt-winding provided for one of said cores, a close-circuited conductor for the other, a damping-magnet and a counting-train, as and for the purpose described.

7. In an electric meter, the combination with a counting-train, of an armature engaging therewith, a magnet influencing said armature, means for producing two constant alternating magnetic fields acting on said armature having ninety degrees phase displacement, or approximately so, whose axes are identical, and means for producing a third and variable magnetic field reacting on said armature in such a plane that its flux-path is non-intersecting with the magnet whose flux lags most, substantially as described.

8. In a shunt-field-magnet system, the combination with two cores of the shunt-magnet, of a winding for one of said cores connected across a circuit, adapted to energize the second core, and means applied to said second core to produce a magnetic retardation, substantially as described.

9. In a shunt-magnet system for motors or meters, the combination with two cores of the shunt-magnet, one of said cores being provided with a winding serving to magnetize the other core, of means for superimposing a secondary flux upon said second core, substantially as described.

10. A magnet system for motors or meters consisting of two cores, one carrying a flux produced by a primary current, and means applied to the second core for producing secondary currents in or around said second core exclusively by the flux of said first magnet, substantially as described.

11. In a meter, the combination with an armature, of a shunt-magnet system consisting of two cores, one energized by primary currents, the other by secondary currents, both magnets producing flux-paths so disposed relatively to one another as to exert no turning movement upon the armature common to said cores, substantially as described.

12. In an electric meter, the combination with an armature adapted to rotate, of a current-winding, a retarding-magnet, a primary pressure-winding, a measuring element, and a magnet system for the pressure-winding consisting of two separate cores, one energized by the pressure-winding, the second inductively from the first, and means for establishing a secondary flux in said second core.

13. In a meter-energizing system, the combination with an armature, of a current-winding, a main shunt-electromagnet, a supplemental magnet-core receiving primary flux from the main shunt-electromagnet, and means to superpose a secondary flux upon the said supplemental core, substantially as described.

14. In a meter-energizing system, the combination with an armature adapted to rotate, of a current-winding acting on said armature, a shunt-electromagnet reacting on said armature, and a second electromagnet differing in phase from said shunt-magnet also reacting on said armature, disposed with relation to said shunt-magnet to have the armature remain at rest when the current-winding is open-circuited, substantially as described.

15. In an electric-meter-energizing system, the combination with an armature, of a current-winding, a shunt-electromagnet, a second magnet-core closing the magnetic circuit of the first, the armature or a portion thereof being interposed between said cores, and a closed winding disposed on said second core receiving its flux exclusively from said first magnet, substantially as described.

16. In an induction-motor, the combination with a movable element, of windings for producing three separate energizing-fields coacting in producing rotation, two of said windings having independent or uncommon cores.

17. An adjustment for modifying a magnetic field of a motor, consisting of a stationary core part and a movable core part eccentrically pivoted with relation to the armature, substantially as described.

18. In an adjustment for modifying a magnetic field of a motor, the combination with a main body or magnet-core, of a supplemental core, a pivot for the supplemental core near one end thereof, and suitable means for moving said supplemental core at its other end, substantially as described.

19. In a friction-reducing device for meters, the combination with an armature, of a magnetizable plate mounted on said armature, a magnet in a stationary position, arranged in close proximity to said plate, producing attraction against the weight of said armature, said plate being interposed between the armature and magnet, substantially as described.

20. In a friction-reducing device, the combination with a rotating armature, of a magnet and a magnetizable shield interposed between said armature and said magnet, as and for the purpose described.

21. In a friction-reducing device, the combination with a magnet, of an energizing-coil mounted on said magnet, an armature in close proximity to the poles of said magnet, and a magnetizable plate forming the upper

end of said armature having one of its sides exposed to said magnet-poles, substantially as described.

22. In a friction-reducing device, the combination with a stationary magnet, of an energizing-coil for said magnet, an armature operating the latter, and a magnetic shield interposed between the fields actuating said armature and the field of the first-named magnet, substantially as described.

In witness whereof I hereunto subscribe my name this 23d day of May, A. D. 1900.

LUDWIG GUTMANN.

Witnesses:
FLORENCE WICKLIN,
HARVEY L. HANSON.