No. 698,662. Patented Apr. 29, 1902.

T. DUNCAN.

ELECTRIC METER.

(Application filed Sept. 29, 1899. Renewed Nov. 15, 1901.)

(No Model.) 4 Sheets—Sheet i.

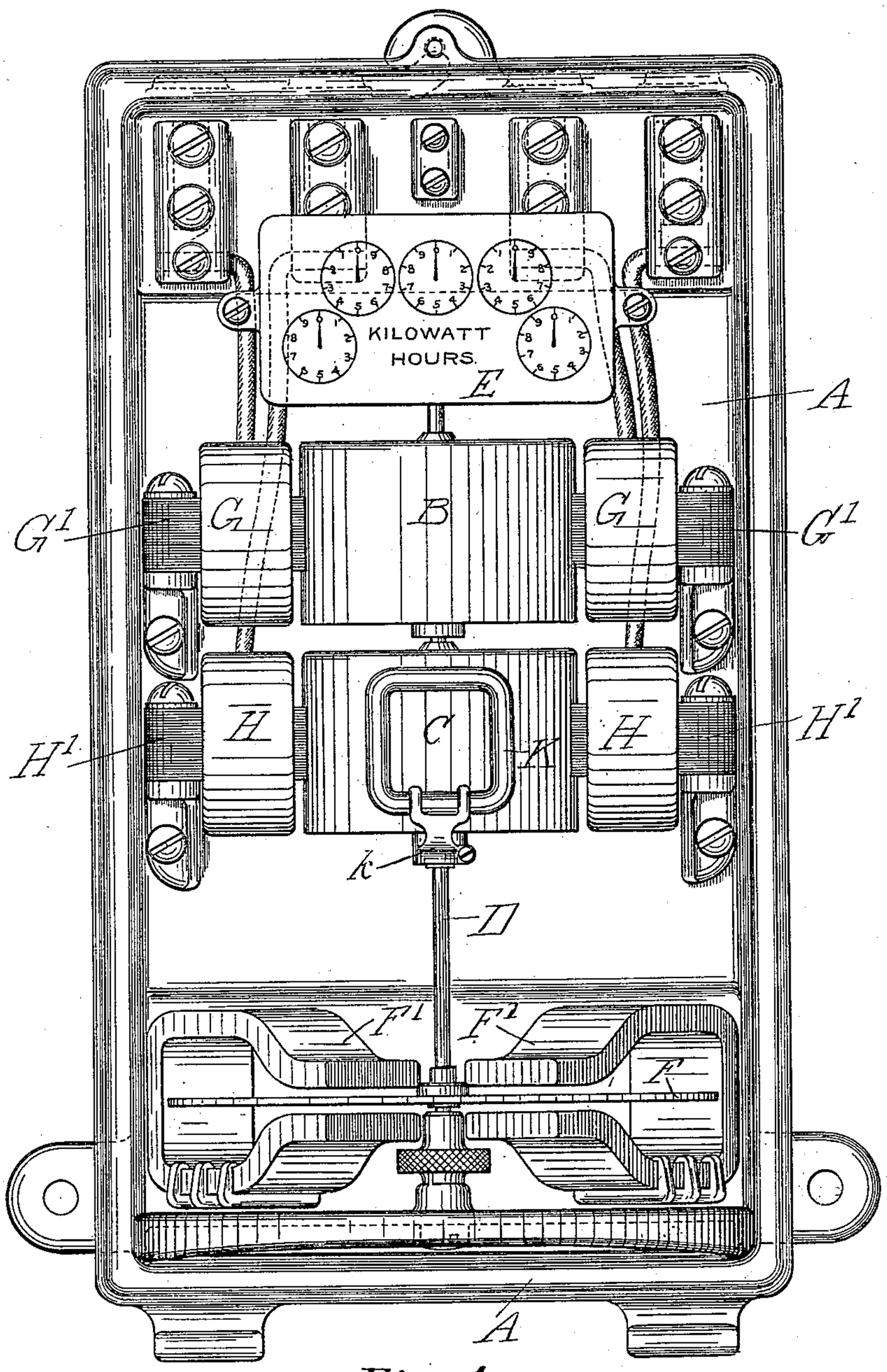

Fig. 1.

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(No Model.) 4 Sheets—Sheet 2.

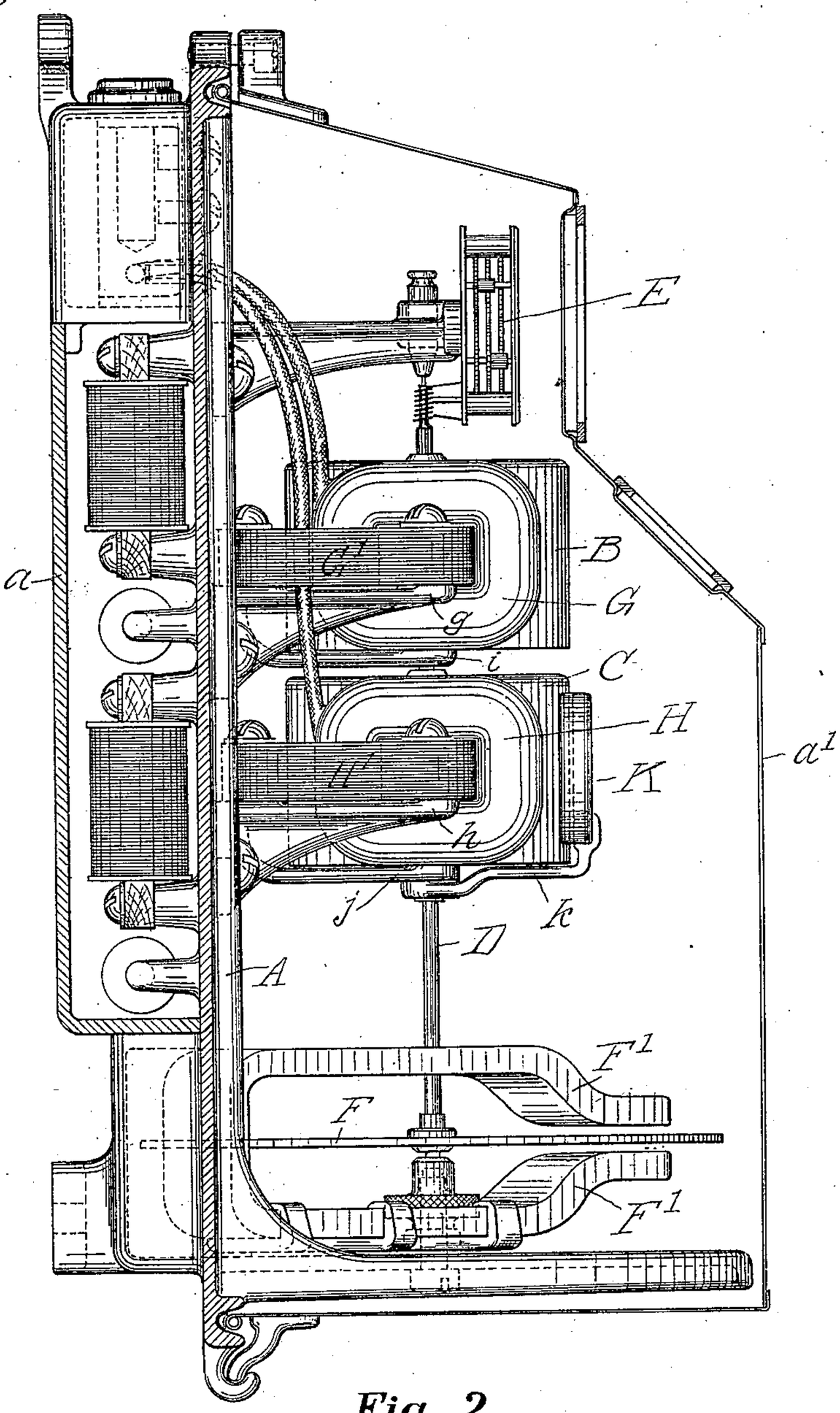

Fig. 2.

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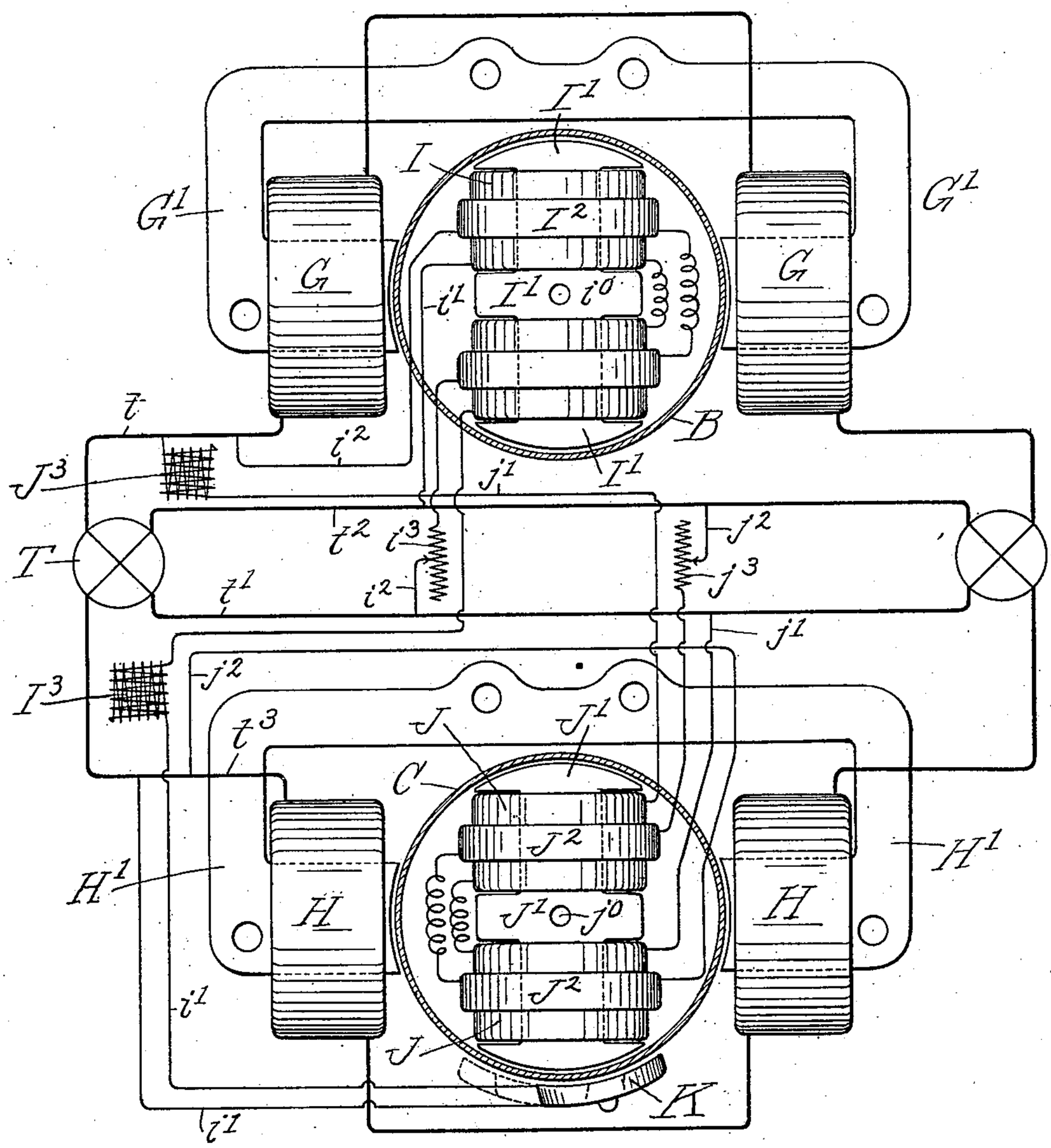
Fig. 3.



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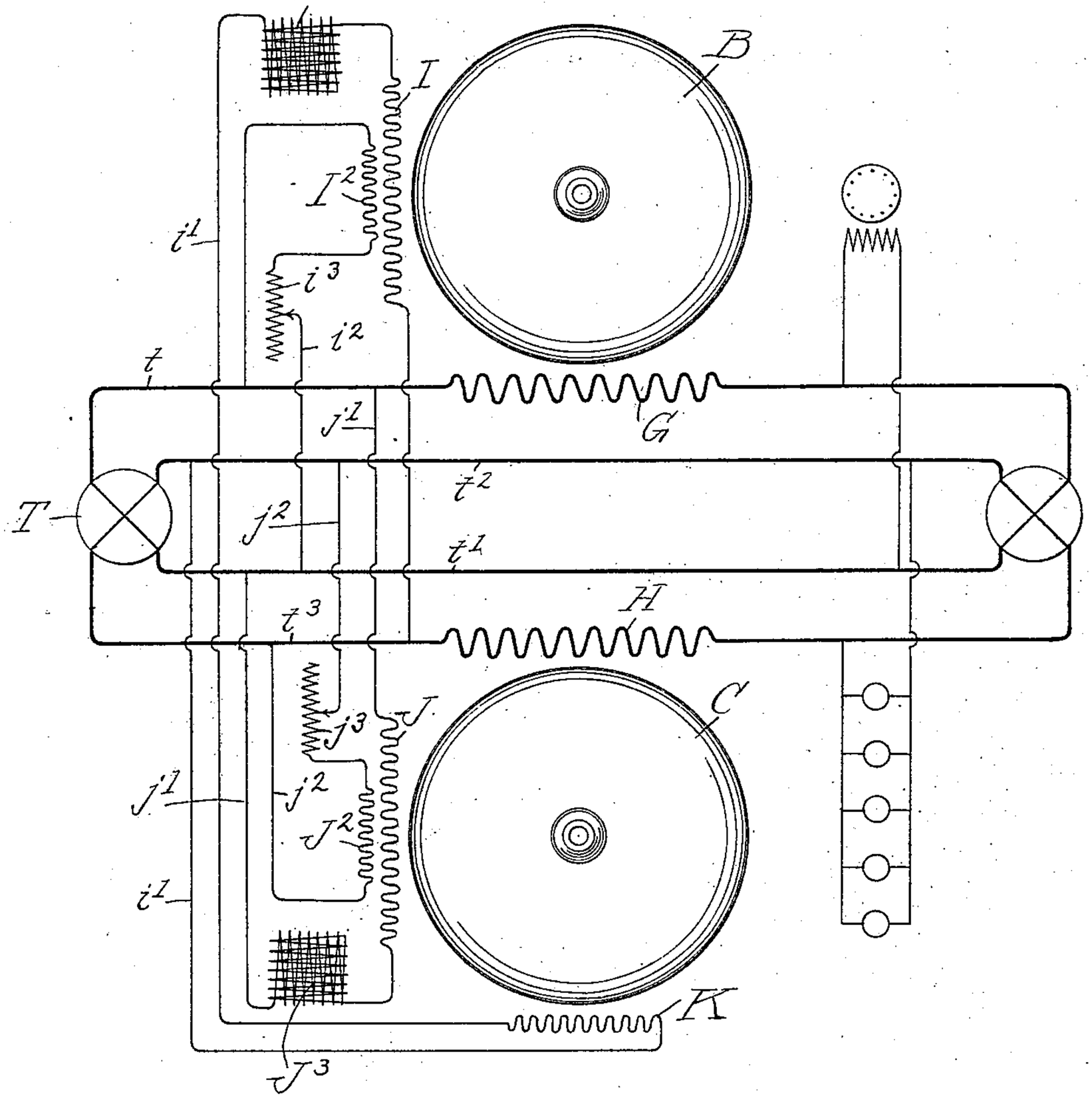
(No Model.) 4 Sheets—Sheet 4.

Fig. 4.



Witnesses
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UNITED STATES PATENT OFFICE.

THOMAS DUNCAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 698,662, dated April 29, 1902.

Application filed September 29, 1899. Renewed November 15, 1901. Serial No. 82,418. (No model.)

To all whom it may concern:

Be it known that I, THOMAS DUNCAN, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Meters, (Case No. 61,) of which the following is a specification.

This invention relates to improvements in induction motor-meters for polyphase work, and particularly for bi or two phase systems of distribution.

Among the objects of the invention are to insure accuracy of measurement under either inductive or non-inductive loads by providing that the magnetic field representing the electromotive force if each circuit shall lag ninety degrees behind said electromotive force, as is now generally the case in well-constructed single-phase induction-meters, to utilize one of the shunt-currents in overcoming the friction and inertia of the revoluble parts of the meter, and generally to provide an improved instrument of the character referred to.

The invention consists in the matters herein set forth, and particularly pointed out in the appended claims.

In the accompanying drawings, Figure 1 is a front elevation of a meter constructed in accordance with my invention. Fig. 2 is a side elevation thereof. Fig. 3 is a partially diagrammatic view of the two motor parts and connections. Fig. 4 is a diagrammatic view of the circuits.

In said drawings, A designates the meter-frame, and B and C two revoluble closed-circuit armatures secured upon a common spindle D, which is suitably mounted to rotate freely and register its revolutions on a registering mechanism E, a disk F being also secured on the spindle to rotate between drag-magnets F′ and form the usual retarding device. Series field-coils G and H are supported on opposite sides of the two armatures B and C, respectively, upon the inwardly-projecting poles of laminated iron or steel cores G′ and H′, which are screwed down upon the brackets *g* and *h*, that project from the back of the meter-frame, Fig. 1. The field-coils G are connected in series in one of the main circuits $t\,t'$ of the two-phase generator T, Figs. 3 and 4, while the other field-coils H are similarly connected in the other main circuit $t^2\,t^3$ of the generator T. The shunt-coils I and J are herein shown as located within the armatures, which are in this instance made cylindric or of inverted-cup form upon laminated sheet iron or steel cores I′ and J′, that are carried upon brackets *i* and *j*, which project from back of the meter-frame, Fig. 2, said cores being centrally apertured at i^0 and j^0 to permit the spindle D to pass freely up through them. These field-coils are in each case in shunt between the main leads of the opposite circuit from that in which the corresponding field-coils are connected—*i. e.*, the volt-coils I within the upper armature B are connected in a shunt-circuit i' between the leads t^2 and t^3 of the circuit in which the lower field-coils H are connected in series, while the volt-coils J within the lower armature C are connected in a shunt-circuit j' between the main leads *t* and t' of the circuit in which the upper field-coils H are connected in series. The volt-coils for each armature would then be energized by a current lagging ninety degrees behind the impressed electromotive force of the current passing through the series field-coils for that armature were it not for the self-inductance of the shunt-coils, which still further increases the lag. To counteract this effect and restore the lag to the exact ninety degrees requisite to accurate working under inductive loads, subsidiary volt-coils I^2 and J^2 are placed in inductive relation to the main volt-coils I and J, respectively, and are each connected in shunt between the leads of the same circuit as the adjacent series field-coil, the subsidiary volt-coils I^2 of the upper armature being connected in a shunt-circuit i^2 between the leads $t\,t'$ of the circuit in which the upper field-coils G are connected in series and the subsidiary volt-coils J^2 of the lower armature being connected in a shunt-circuit j^2 between the leads $t^2\,t^3$ of the circuit in which the lower field-coil H are connected in series. The currents through the subsidiary coils will then so vary in phase from the current in their corresponding main volt-coils as to produce, if properly proportioned, a resultant current

effect or volt-field which will be displaced in phase by exactly ninety degrees from the impressed electromotive force of the circuit in which their said corresponding series field-coils are connected, thus accomplishing one of the principal objects of the present invention. Adjustable resistances i^3 and j^3 are shown as inserted in the subsidiary circuits i^2 and j^2, respectively, to permit the necessary adjustment and calibration of the meter, these coils, together with the usual resistance-coils I^3 and J^3 of the main shunt-circuits, being herein shown as conveniently located on the back of the meter beneath a cover or lid *a*, provided on the back of the meter-frame for their protection. The working parts on the front of the meter are also shown as protected in the usual manner by a removable casing *a'*, having suitable glazed side apertures, through which the readings may be taken and the parts inspected.

To overcome the friction and inertia of the revolving parts, a compensating-coil K is herein shown as adjustably supported in front of the armature C by a swinging arm *k*, which is pivotally secured on the front end of the bracket *j*, concentric with the armature. This coil is shown as connected in the shunt-circuit *i'* with the volt-coil I of the armature B, so that if adjusted to stand with its axis at an angle to the axis of the volt-coils *j* of its own armature a resultant shifting field tending to rotate said armature will be set up between the coils, the intensity of this field depending upon the position to which the coil K is adjusted.

It will be understood that the invention is unlimited to the particular mechanical arrangements described or to cylindric or cup-shaped armatures and that the same plan for securing the ninety-degree lag desired may be utilized in other polyphase systems having circuits in quadrature.

I claim as my invention—

1. An electric meter for two-phase systems comprising a pair of revoluble armatures, series and volt coils for both armatures, the series coils of the two armatures being connected in the separate circuits of the system, and the volt-coils in each case being connected between the leads of that circuit in which the other field-coils are connected, subsidiary volt-coils applied to the main volt-coils of each armature and connected in shunt between the leads of the circuit in which the series coils of that armature are connected, and means for registering the armature rotation.

2. An electric meter for two-phase systems comprising a pair of armatures secured upon a common spindle, series coils connected in series in one of the circuits and mounted in inductive relation to one of the armatures, other series coils connected in series in the other circuit and mounted in inductive relation to the other armature, volt-coils mounted in inductive relation to the first armature and connected in a shunt between the leads of that circuit in which the series coils of the second armature are connected, volt-coils mounted in inductive relation to the second armature and connected in shunt between the leads of that circuit in which the field-coils of the first armature are connected, subsidiary volt-coils mounted in inductive relation to the main volt-coils of each armature, said subsidiary coils for each armature being connected in shunt between the leads of the circuit in which the series coils of that armature are connected, and a registering mechanism operatively connected with said spindle.

3. An electric meter comprising a pair of revoluble armatures, series and volt coils for both armatures, and means for registering the armature rotation, the series coils of the two armatures being connected in the separate circuits of the systems and the volt-coils of each armature being connected in shunt between the leads of the circuit in which the series coils of the other armature are connected, and a compensating-coil adjustably mounted in proximity to one armature and connected in the shunt-circuit with the volt-coils of the other armature.

4. An electric meter for two-phase systems comprising a pair of armatures secured upon a common spindle, series coils connected in series in one of the circuits and mounted in inductive relation to one of the armatures, other series coils connected in series in the other circuit and mounted in inductive relation to the other armature, volt-coils mounted in inductive relation to the first armature and connected in a shunt between the leads of that circuit in which the series coils of the second armature are connected, volt-coils mounted in inductive relation to the second armature and connected in shunt between the leads of that circuit in which the field-coils of the first armature are connected, subsidiary volt-coils mounted in inductive relation to the main volt-coils of each armature, said subsidiary coils for each armature being connected in shunt between the leads of the circuit in which the series coils of that armature are connected, and a compensating-coil adjustably mounted in proximity to one armature and connected in the shunt-circuit with the volt-coils of the other armature, and a registering mechanism operatively connected with said spindle.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two subscribing witnesses, this 25th day of September, A. D. 1899.

THOMAS DUNCAN.

Witnesses:
WILLIAM F. MEYER,
JOS. M. KARTHOLL.