No. 619,733. Patented Feb. 21, 1899.

T. DUNCAN.

ELECTRIC METER.

(Application filed May 16, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

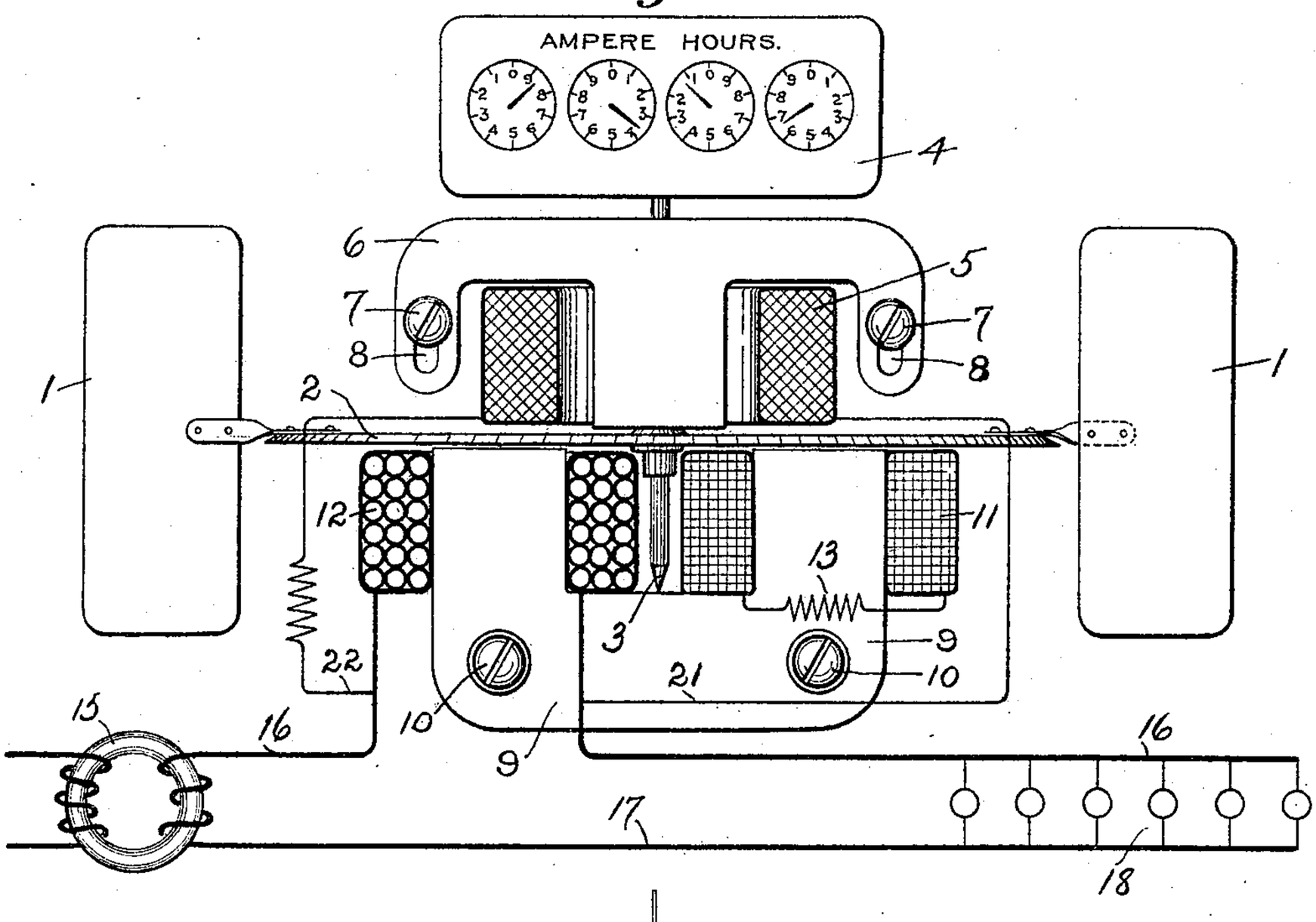
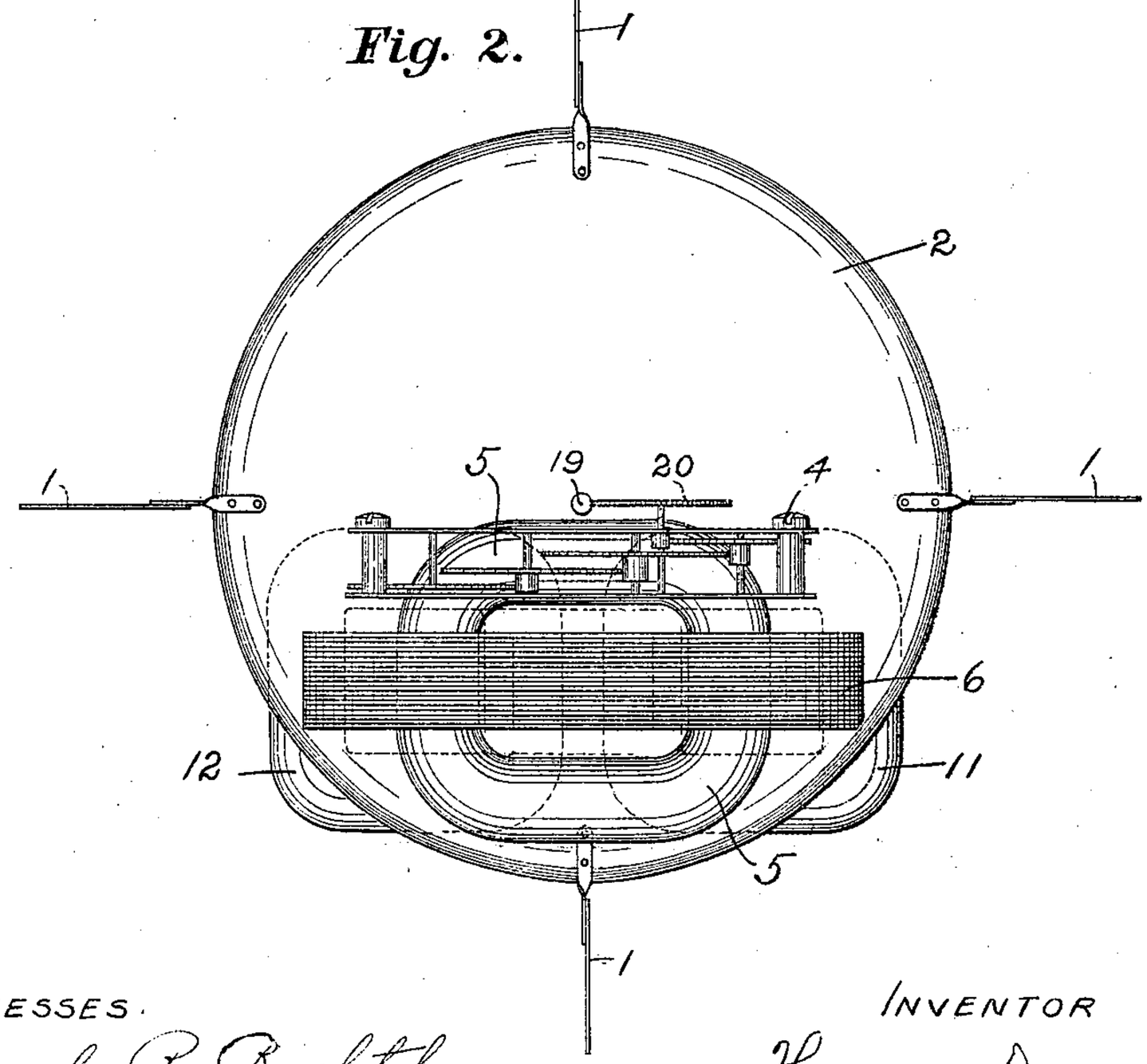


Fig. 2.



WITNESSES.
Samuel R. Bachtel
William Murray

INVENTOR
Thomas Duncan.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 3.

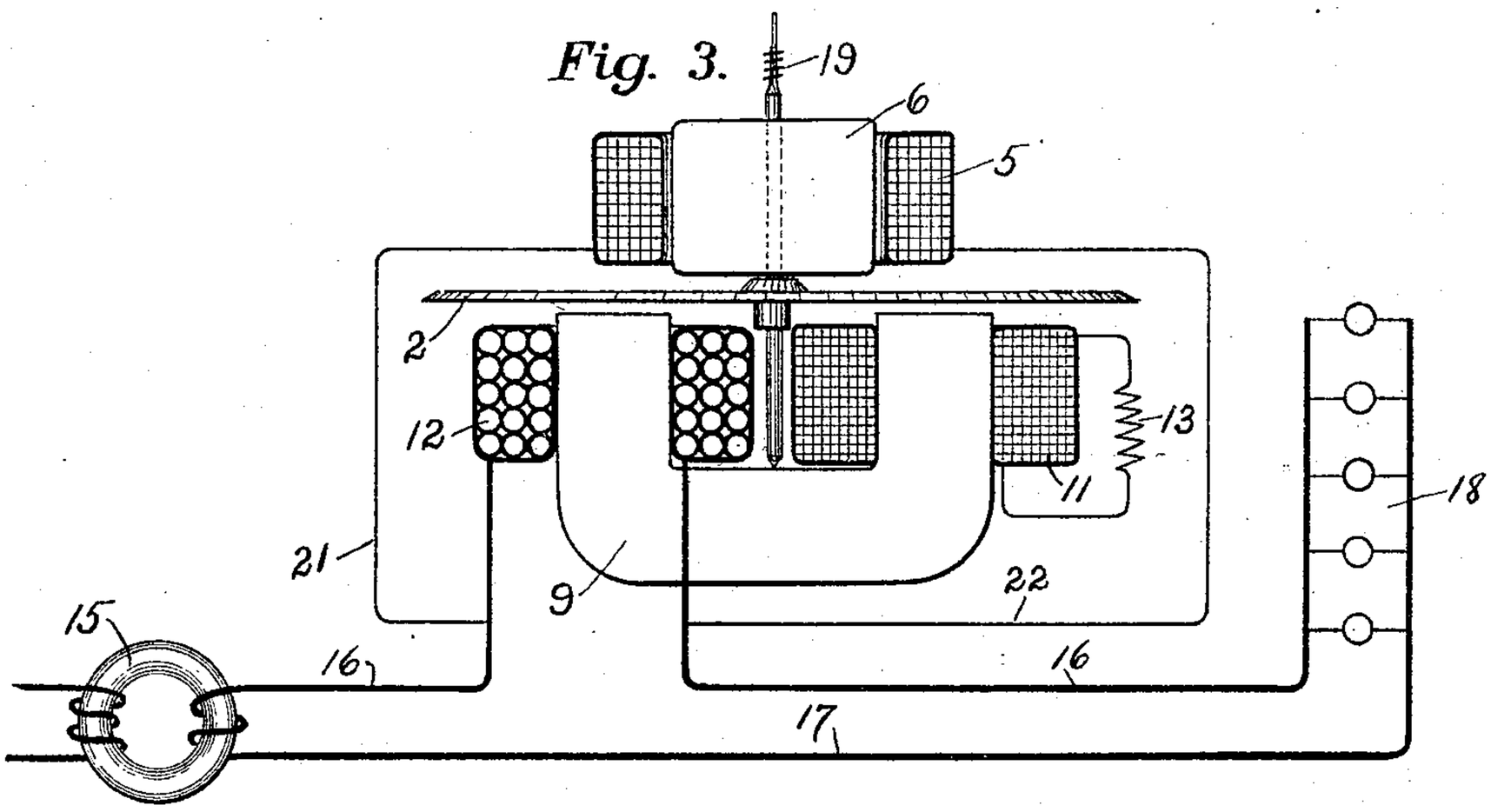


Fig. 4.

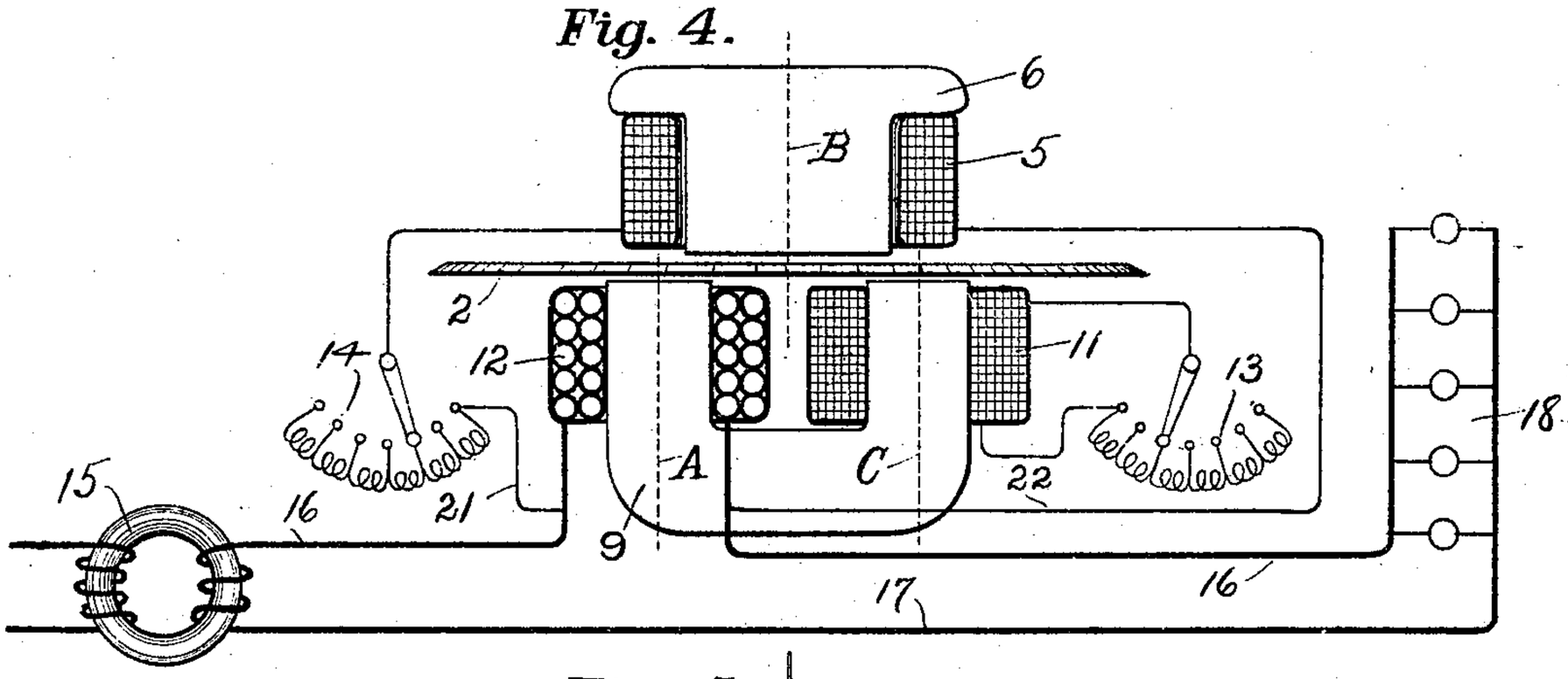
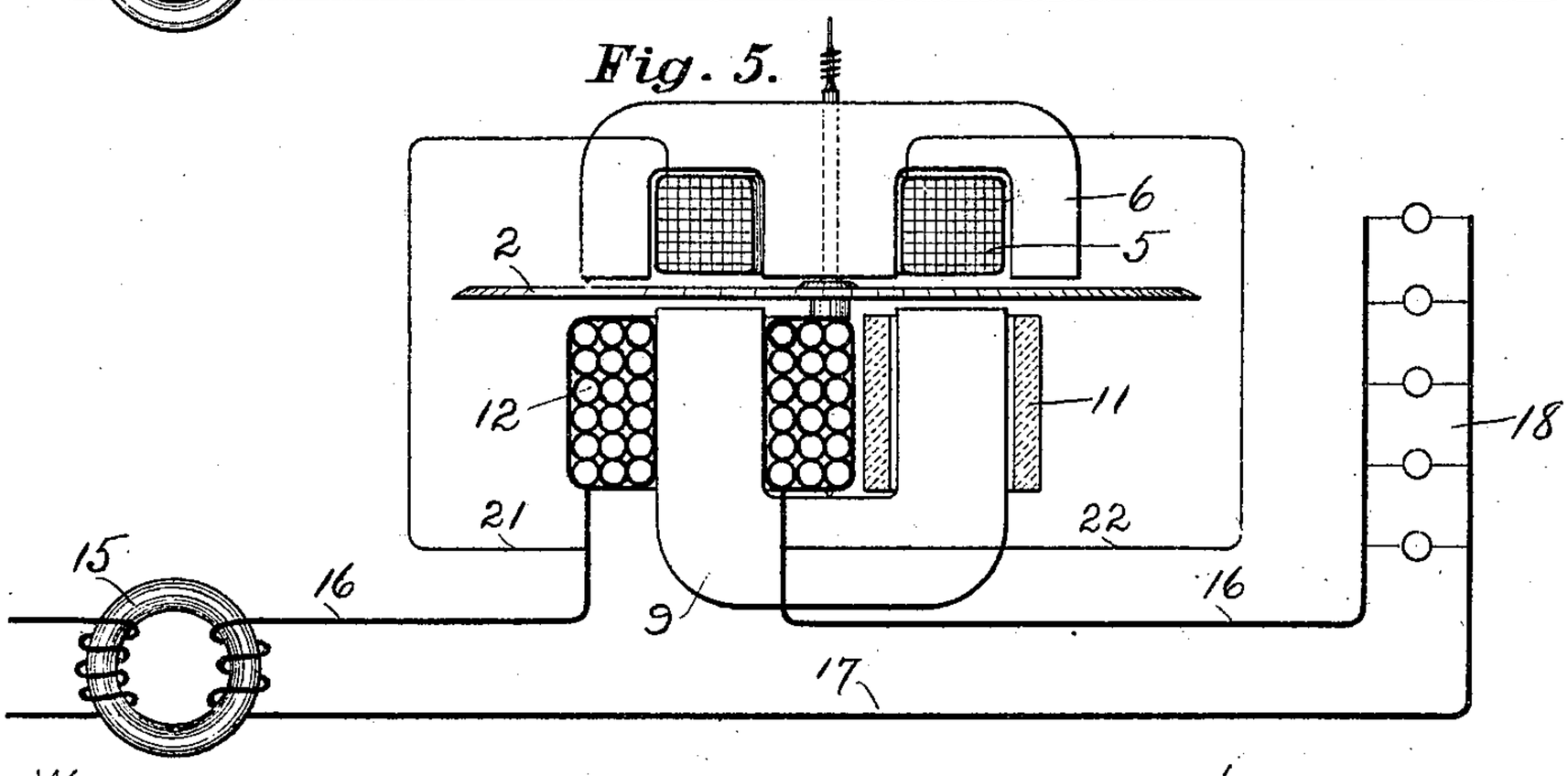


Fig. 5.



WITNESSES.

Samuel R. Bachtel

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INVENTOR.

Thomas Duncan

UNITED STATES PATENT OFFICE.

THOMAS DUNCAN, OF FORT WAYNE, INDIANA.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 619,733, dated February 21, 1899.

Application filed May 16, 1898. Serial No. 680,808. (No model.)

To all whom it may concern:

Be it known that I, THOMAS DUNCAN, a citizen of the United States, residing at Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Electric Meters, of which the following is a specification.

My invention relates to improvements in meters for measuring alternating electric currents and of the type known in the art as "coulomb" or "ampere" hour motor-meters.

The objects of the invention are the production of maximum torque with minimum expenditure of energy, a straight-line characteristic to give a rate of rotation that is always proportional to the current in amperes through the meter, a reduction in weight of the revoluble parts to assist in eliminating the friction and inertia and insuring its starting to register with small currents, a wide range of adjustment for standardizing purposes, and an applicability to currents of widely-different periods, mechanically compact, and easily repaired and cheaply manufactured.

In the accompanying drawings, Figure 1 is a front elevation showing the energizing-coils of the meter in section. Fig. 2 is a plan view of the same, showing only the relative position of the said energizing-coils, registering-train, and the aluminium disk armature. Fig. 3 is similar to Fig. 1, with the exception of the shape of the iron core within the coil upon the upper side of the disk armature. Fig. 4 shows variable resistances in connection with two of its energizing-coils. Fig. 5 has a multipolar iron core in coöperative relation with the energizing-coil upon the upper side of the disk armature.

The principal elements of my invention are a series field-coil 12, that is traversed by the main current; a secondary field-coil 11, receiving its current by induction from the said series coil 12; a U-shaped iron core 9 for the said series and secondary coils; a revoluble aluminium disk armature 2 in inductive relation to the said series and secondary coils; a third energizing-coil 5, receiving currents by conduction from the said series field-coil and placed upon the opposite side of the said disk armature from the said series and secondary coils and coöperating inductively with said series and secondary coils and said disk armature; an adjustable iron core 6 in coöperative relation with the said third energizing-coil 5, and a retarding device consisting of aluminium wings or fans 1, secured rigidly to the said disk armature 2.

The operation of the meter is as follows: An alternating current from the transformer 15, Fig. 1, passes around the series field-coil 12 and through the leads 16 and 17 and the incandescent lamps 18. The magnetism set up by the said coil 12 traverses the iron core 9, and in so doing generates a current in the coil 11, the strength of which is varied by the introduction of a suitable resistance 13 in series with said coil 11. The current in the coil 11 will lag more than ninety degrees behind the current in the coil 12, depending upon the amount of self-induction it contains. The terminals 21 and 22 of the third energizing-coil 5 are connected to the terminals of the series coil 12, and since the said coil 5 has a greater number of turns than the coil 12 its self-induction will be greater, which causes its current to also lag behind the current through the coil 12, but by an amount that is less than ninety degrees. This arrangement gives three magnetic fields of different time periods or phases from a single-phase-current source, all of which combine in producing a resultant shifting magnetic field that actuates the disk armature 2 by inducing eddy-currents in the latter, which react upon the said shifting field and is set in rotation thereby. To vary the speed in calibration, the adjustable iron core 6 may be moved vertically by means of the slots 8 and set-screws 7. The speed may also be adjusted by the use of the resistance 14 in series with the coil 5 or the resistance 13 in series with the secondary coil 11. The said resistance can also be employed for adjusting the phase of the current through their respective coils. The disk armature 2 is suitably mounted upon a spindle 3, which has a meshing connection 19 with the worm-wheel 20 of the registering mechanism 4. The iron core 9 may be supported in any desirable manner or with the set-screws 10, as shown. In this type of meter the torque varies, as the square of the current through the series coil 12, and in consequence a retarding force must be applied

in the nature of a winged fan, so as to make the speed proportional to the current in amperes passing through it. In carrying this out I secure the aluminium wings 1 around the periphery of the disk armature, as shown, so that the said disk not only serves as the motor-armature, but as a support for the retarding-wings. In this respect the weight of the revoluble parts are reduced to a minimum and differs from other meters of this class which have the retarding fan or wings separately attached to the spindle, which makes them large and cumbersome.

The three magnetic axes of the energizing-coils are shown in Fig. 4, in which A represents the axis of the series coil 12, B that of the coil 5, and C of the secondary coil 11. The secondary-coil winding 11 of Figs. 1, 2, 3, and 4 is replaced in Fig. 5 by a closed piece of metallic tubing.

By means of the resistances 13 and 14 it is possible to so adjust the phase of the current and magnetism of the coils 12, 11, and 5 that the interval or time period between them will be uniform. If it be assumed, for example, that the current and magnetism of the series coil 12 is in phase with the electromotive force of the transformer 15, the resistance 14 can be adjusted until the current and magnetism of the coil 5 lags, say, sixty degrees behind the current and magnetism of the said coil 12, and since the energizing-coil 11 receives its current by induction from the coil 12 the said current in 11 must necessarily lag ninety degrees behind the current and magnetism of the coil 12 plus the lag due to its own self-induction. The self-induction of the coil 11 may be adjusted with the resistance 13 until its current lags thirty degrees behind its own electromotive force and which makes it ninety plus thirty, or one hundred and twenty degrees, behind the current in coil 12. This gives a difference of phase of sixty degrees between the magnetic axes A and B and B and C, or when the current and magnetism of the coil 12 is at zero that of the coil 5 will be sixty degrees behind that of the coil 12 and the current and magnetism of the coil 11 will be sixty degrees behind that of the coil 5 and one hundred and twenty degrees behind that of the coil 12.

The several parts constituting the invention may be assembled in any suitable manner which will assist in making the meter compact and easily constructed.

I claim as my invention—

1. In an electric meter the combination of the series energizing-coil 12, the U-shaped iron core 9, the secondary energizing-coil 11, the shunted energizing-coil 5, and the revoluble disk armature 2.

2. In an electric meter the combination of the series energizing-coil 12, the secondary energizing-coil 11, the shunted energizing-coil 5, the revoluble disk armature 2, and the wings of fans 1 secured to the said armature 2.

3. In an electric meter the combination of a series coil 12, a secondary coil 11 receiving currents by induction from the said series coil 12, a U-shaped iron core in coöperative relation with the said series coil 12 and the said secondary coil 11, a shunted coil 5 receiving current by conduction from the said series coil 12, a revoluble disk armature, and suitable retarding wings or vanes 1 secured to and revolving with the said armature 2.

4. In an electric meter the combination of a series coil 12, a secondary coil 11, a resistance 13 in series with the said coil 11, a shunted coil 5, a resistance 14 in series with the said coil 5, an aluminium disk armature 2 in inductive relation to the said coils 12, 11 and 5, retarding-vanes 1 secured to and revoluble with the said disk armature 2, and a suitable registering-train 4.

5. In an electric meter the combination of a series coil 12, a secondary coil 11, a shunted coil 5, an adjustable iron core 6 in coöperative relation with the said coil 5, suitable means for adjusting the position of the said core 6 by means of the slots 8 and screws 7, a revoluble disk armature in inductive relation to the said coils 12, 11 and 5, and means for retarding the revolutions of the armature by the attachment of suitable vanes or wings 1 around its perimeter.

In testimony that I claim the foregoing as my invention I have signed my name, in the presence of two witnesses, this 9th day of May, 1898.

THOMAS DUNCAN.

Witnesses:
M. GRACE WEBBER,
JOHN E. DALTON.