

No. 698,652.

Patented Apr. 29, 1902.

T. DUNCAN.  
ELECTRIC METER.

(Application filed Aug. 28, 1899.)

(No Model.)

2 Sheets—Sheet I.

Fig. 1.

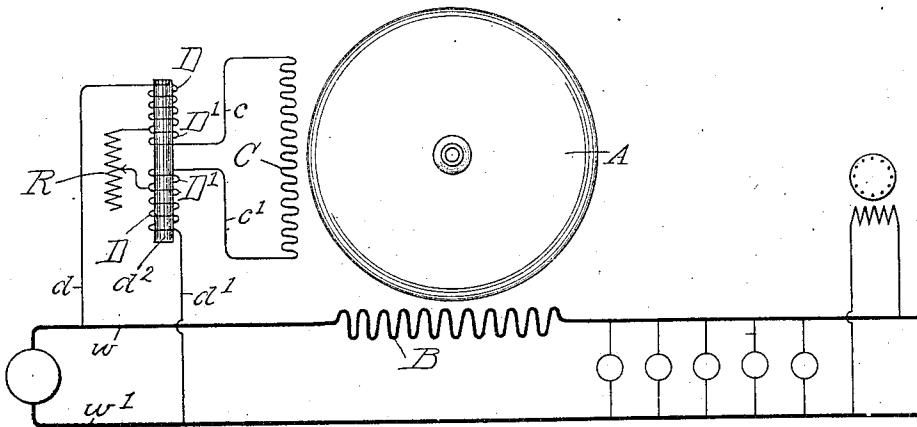
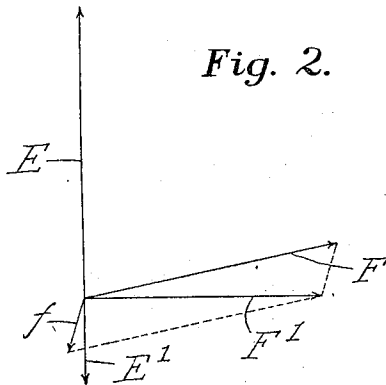


Fig. 2.



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Fig. 3.

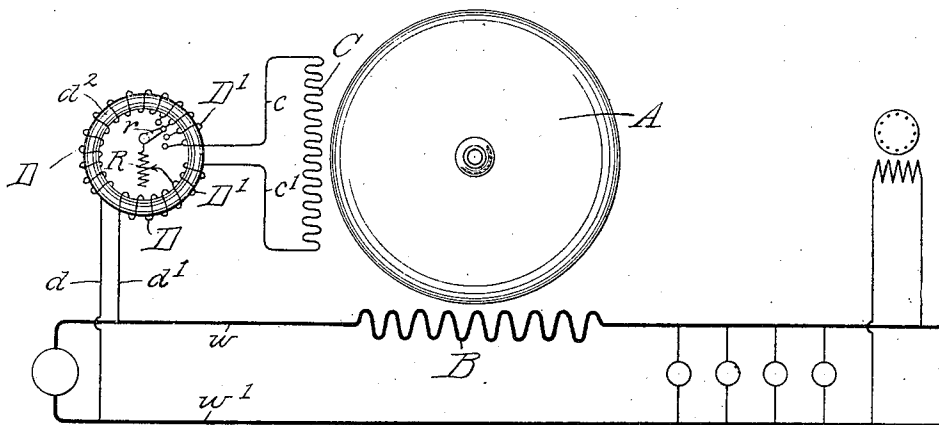
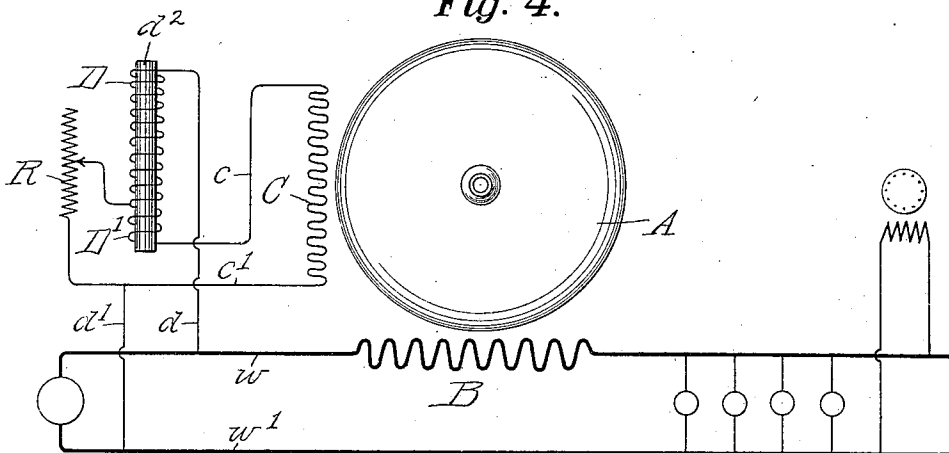


Fig. 4.



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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. 698,652, dated April 29, 1902.

Application filed August 28, 1899. Serial No. 728,690. (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. 60,) of which the following is a specification.

This invention relates to improvements in induction motor-meters for alternating-current work, and particularly to means for obtaining in such meters a magnetic field in quadrature with the electromotive force which it represents.

The invention consists in the matters hereinafter described, and particularly pointed out in the appended claims, and will be fully understood from the following detailed description of the constructions illustrated in the accompanying drawings, in which—

Figures 1, 3, and 4 are diagrammatic views of meters embodying my invention. Fig. 2 is a vector diagram of the essential current effects.

As shown in said drawings, A designates the rotary armature of the meter, B and C its series and volt coils, and D an impedance coil or coils connected in series with the volt field-coil C in a shunt-circuit between the main leads  $w$  and  $w'$  of the work-circuit.

R designates a resistance shunted around the coil C, so that it is in parallel with said coil between the terminals  $d$  and  $d'$  of the main shunt-circuit. This resistance R is so connected as to include more or less of the turns D' of the coil or coils D and may be said to complete a subordinate circuit in which such included turns D' are in series with said resistance and with the volt field-coil C.

As shown in Fig. 1, the impedance-coil D consists of two separate sections or coils each connected with one of the terminals  $c$   $c'$  of the coil C, and the resistance R is connected to include a portion of the turns of both sections. In Fig. 3 the construction is similar, except that the common core  $d^2$  of the impedance-coil is an annular ring instead of a straight bar. In this figure also an adjustable switch  $r$  is shown as provided between one terminal of the resistance E and the adjacent coil D to permit more or less of the

turns D' of the latter to be cut in or out, as desired. In Fig. 4 the impedance-coil is a single coil, which the shunted resistance R connects directly to the terminal  $d'$  of the main shunt, to which latter the terminal  $c'$  of the coil C is also connected. In each case the said resistance R is desirably made variable for purposes of adjustment.

The action of the shunt R in producing a lag of ninety degrees in the coil C may be understood by reference to Fig. 2, in which the line E represents the impressed electromotive force of the work-circuit and the line F the current to the coil C, as it would naturally be lagged by the impedance-coil. The line E' represents the counter electromotive force set up in the turns D' by the inductive action of the current F and the line  $f$  the current which this counter electromotive tends to set up in the subordinate circuit formed by the resistance R, turns D', and coil C. This current combines with the current F to form the resultant current F', which by proper proportioning and adjustment may be made to lag the exact ninety degrees desired.

I claim as my invention—

1. The combination, with the armature, series and volt field-coils, and impedance-coil in series with the volt field-coil in a shunt-circuit across the line, of a resistance connected in said shunt-circuit in parallel with the field-coil and including the turns of the impedance-coil.

2. The combination, with the armature, series and volt field-coils, and impedance-coil in series with the volt field-coil in a shunt-circuit across the line, of a resistance connected in said shunt-circuit in parallel with the volt field-coil and forming therewith a closed circuit including a portion of the turns of the impedance-coil.

3. The combination, with the armature, series and volt field-coils, and impedance-coil in series with the volt field-coil in a shunt-circuit across the line, of a resistance connected in said shunt-circuit in parallel with the volt field-coil and forming therewith a closed circuit including a portion of the turns of the impedance-coil, and means for varying the number of the included turns.

4. The combination, with the armature, series and volt field-coils, and an impedance-coil connected in series with each terminal of the volt field-coil in a shunt-circuit across the  
5 line, of a resistance connecting said impedance-coils in parallel with the volt field-coil and including a portion of the turns of each.
5. The combination, with an armature, of field-windings therefor, an impedance-coil in  
10 circuit with one of the windings, a resistance in shunt of one of the windings, including

turns of the impedance-coil and forming there-with a closed circuit, substantially as described.

In testimony that I claim the foregoing as  
my invention I affix my signature, in presence  
of two subscribing witnesses, this 23d day of  
August, A. D. 1899.

THOMAS DUNCAN.

Witnesses:

WILLIAM F. MEYER,  
DAYTON N. PETTIT.