

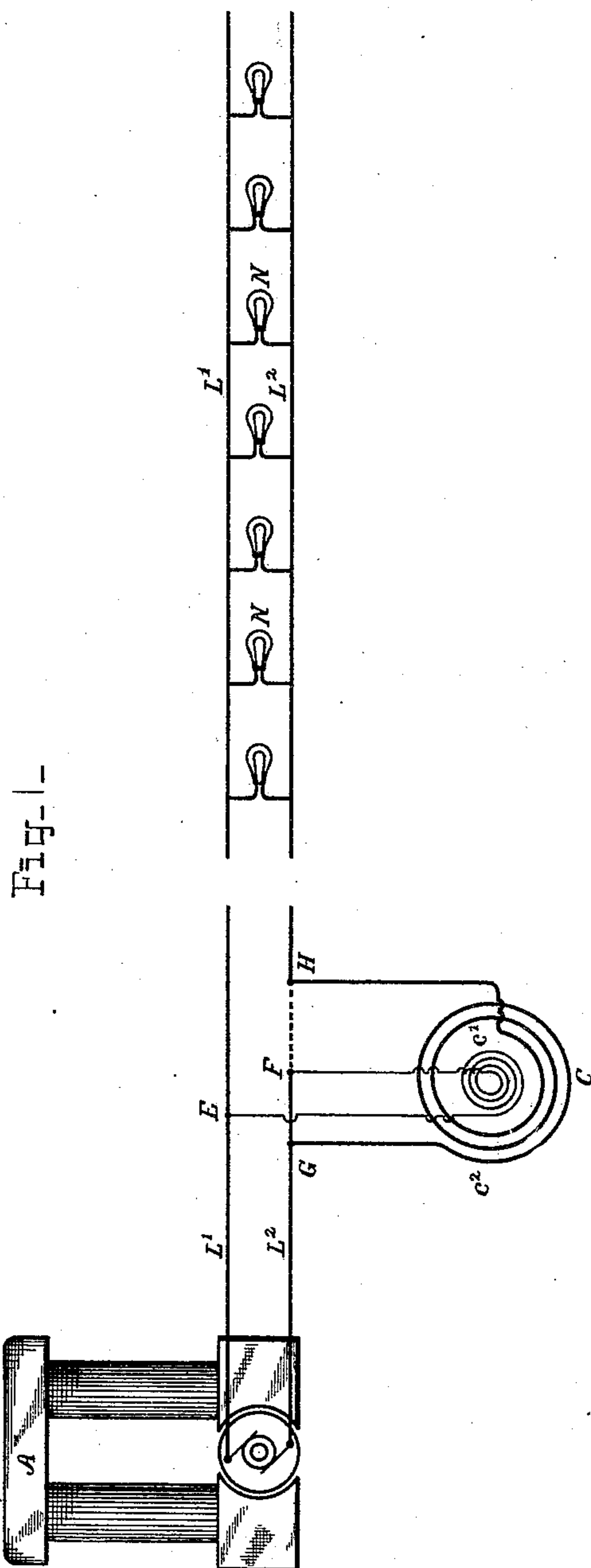
(No Model.)

2 Sheets—Sheet 1.

J. HOPKINSON.  
ELECTRIC INDICATOR.

No. 444,552.

Patented Jan. 13, 1891.



WITNESSES:

*George Brown Jr.*  
*Whitcomb*

INVENTOR,

JOHN HOPKINSON.

*Charles A. Terry.*

Att'y.

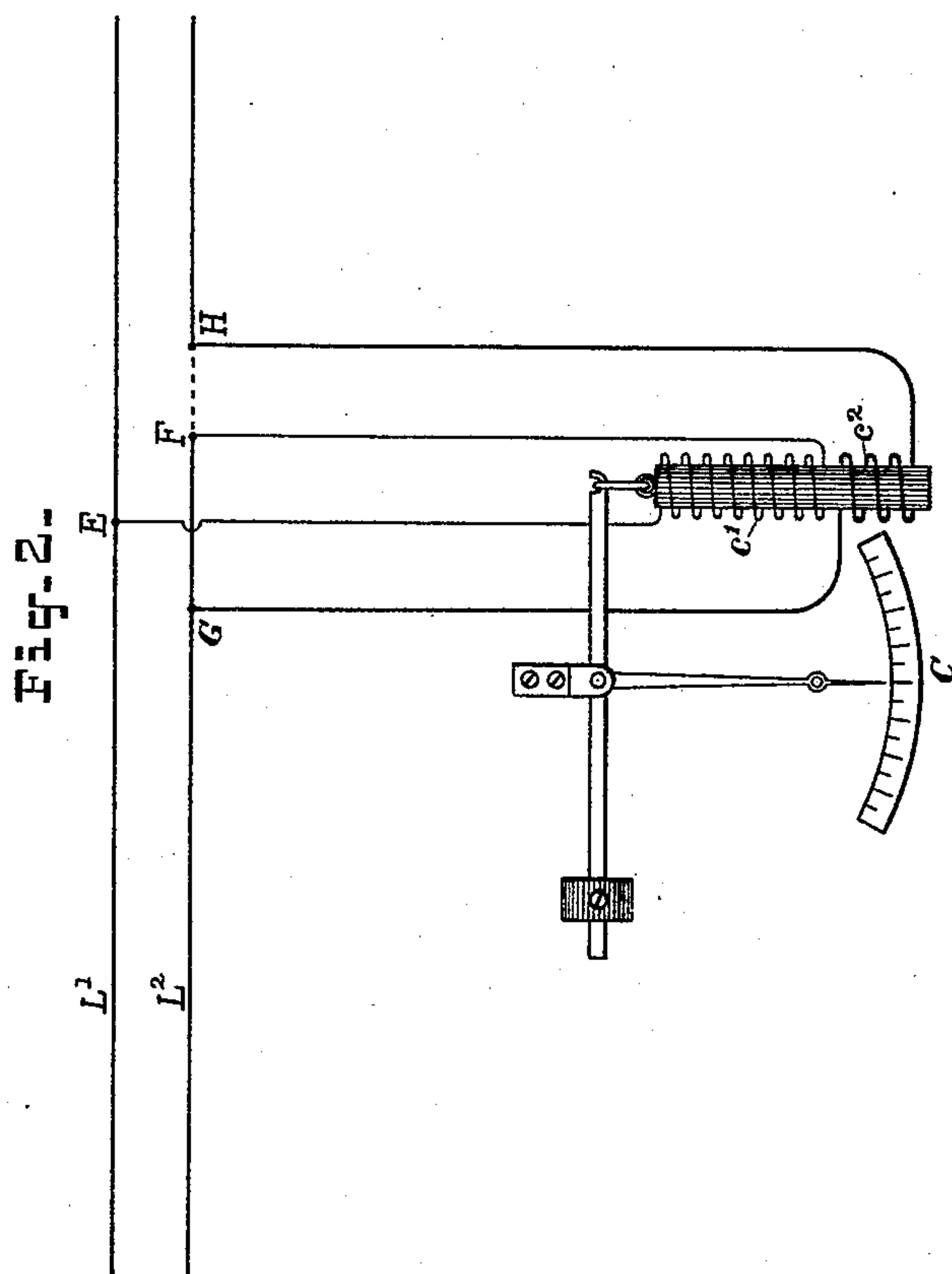
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J. HOPKINSON.  
ELECTRIC INDICATOR.

No. 444,552.

Patented Jan. 13, 1891.



WITNESSES:

George Brown, Jr.  
James Wm. Smith.

INVENTOR,

JOHN HOPKINSON.

Charles A. Terry.

Att'y.

# UNITED STATES PATENT OFFICE.

JOHN HOPKINSON, OF HOLMWOOD, ENGLAND, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, OF PITTSBURG, PENNSYLVANIA.

## ELECTRIC INDICATOR.

SPECIFICATION forming part of Letters Patent No. 444,552, dated January 13, 1891.

Application filed February 23, 1889. Serial No. 300,846. (No model.) Patented in England July 27, 1882, No. 3,576.

*To all whom it may concern:*

Be it known that I, JOHN HOPKINSON, a subject of the Queen of Great Britain, residing in Holmwood, Wimbledon Common, S.W., Westminster Chambers, England, have invented a new and useful Improvement in Electric Indicators, (Case No. 279,) (for which Letters Patent of Great Britain No. 3,576, bearing date of July 27, 1882, have been granted to me,) of which the following is a specification.

My invention relates especially to apparatus for determining the difference of potential existing at a given point in a system of electric circuits supplying translating devices, the special object being to provide an indicator in which the varying drop or loss of potential upon a circuit may be readily compensated for at all times.

When current is supplied by means of main conductors to points more or less distant from a central station, there is a fall of potential, due to the resistance of the conductors, and as the current flowing increases the fall of potential also increases, so that if it is desired to maintain a constant difference of potential at the distant points special means must be employed for determining the loss under any given load. To accomplish this I employ an indicator wound with two opposing coils, one of comparatively high resistance and connected across the terminals of the source of electricity and the other of low resistance, so connected as to be traversed by all or a determinate proportional part of the current flowing to the translating devices. If, now, the current flowing to the work-circuit increases, the effect of the series coil increases correspondingly. If the difference of potential at the terminals of the source be maintained at a normal value, the difference of potential at the terminals of the translating devices will not be as great as before, because of the greater loss or drop upon the circuit which accompanies the transmission of the increased current, so that in order to maintain the proper difference of potential upon the work-circuit it is necessary to increase the difference of potential at the terminals of the source. The increase in difference of potential thus required for com-

pensating for the drop or loss may be determined by properly adjusting the relative effects of the two coils of the indicator.

In the accompanying drawings there is shown in diagram in Figure 1 an organization of apparatus for carrying out the invention. Fig. 2 is a diagram showing the application of the coils to an indicator.

Referring to the figures, A represents a dynamo-electric machine, and N lamps or other translating devices of any suitable character connected in multiple arc between the conductors  $L'$   $L^2$ , leading from the terminals of the machine.

The indicating apparatus is represented at C. It is constructed with two coils  $c'$   $c^2$  opposing each other. The one coil  $c'$  is connected across the poles of the generator A or between the lines  $L'$   $L^2$  at the points E and F. This coil is of fine wire and has a comparatively large number of convolutions. The second coil  $c^2$  is of thick wire, having comparatively few convolutions. It is connected either directly in one of the conductors  $L'$  or  $L^2$  or in a circuit derived therefrom, so that either the whole current or a proportional part thereof will pass through it from the point G to the point H. The current passing through the coil  $c^2$  opposes in effect that through the shunt-coil  $c'$ . I usually prefer to use a proportional part of the current rather than all the current passing through the line  $L^2$ . It is then easy by properly adjusting the relative resistance of the two circuits including the two coils to indicate the compensation required for any given value of resistance of the main lines and thus secure a constant difference of potential between the two conductors at the distant point. The shunt-coil  $c'$  may be made of German silver for the purpose of preventing it from varying materially in its resistance; but this is not necessary.

The differential apparatus may assume various different forms without departing from the essential features of the invention. It may be arranged to indicate directly to the eye when the value of the difference of potential upon the work-circuit requires regulation.

It will be evident that an increase of cur-



rent flowing to the main line will increase the effect of the coil  $c^2$  of the indicator, thereby tending to correspondingly operate the indicator. If no change takes place in the difference of potential at E F, then the indicator will be thrown out of balance. The increased effect of the series coil  $c^2$  in the indicator may be balanced by increasing the difference of potential between the points E and F. By properly adjusting the relative effects of the two coils, therefore, the additional difference of potential required to bring the indicator to its normal position may be made to exactly compensate for the increased drop upon the line, so that the difference of potential at the terminals of the translating devices will be maintained approximately constant if the index of the indicator is kept in a normal position.

I claim as my invention—

1. In an indicator, differentially-wound conductors, one designed to be connected in shunt upon the work-circuit and the other in series therewith, substantially as described.

2. The combination, with a source of elec-

tricity and a work-circuit supplied therefrom, of an indicator having two opposing coils, one connected in shunt upon the work-circuit and the other in series therewith, substantially as described.

3. The combination of a source of electricity, translating devices supplied therefrom, and an indicating apparatus for determining the difference of potential upon the work-circuit, consisting of two opposing coils, one receiving currents proportional to the difference of potential at the terminals and the source and the other receiving currents proportional to the current delivered to the work-circuit, and an indicator operated by the resultant effects of the currents traversing the two coils.

In testimony whereof I have hereunto subscribed my name this 9th day of February, A. D. 1889.

JOHN HOPKINSON.

Witnesses:

S. CRANSON,

E. A. HALL,

*Clerks to Messrs. John Newton & Sons, 9  
Birchin Lane, London, Public Notaries.*