

R. KENNEDY.

ALTERNATING CURRENT TRANSFORMER.

No. 378,320.

Patented Feb. 21, 1888.

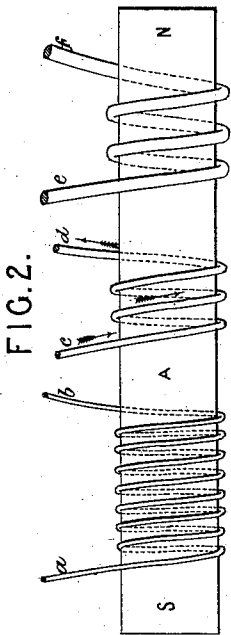


FIG. 2.

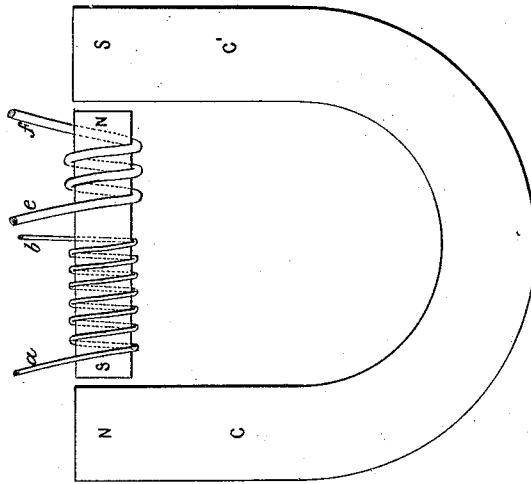


FIG. 4.

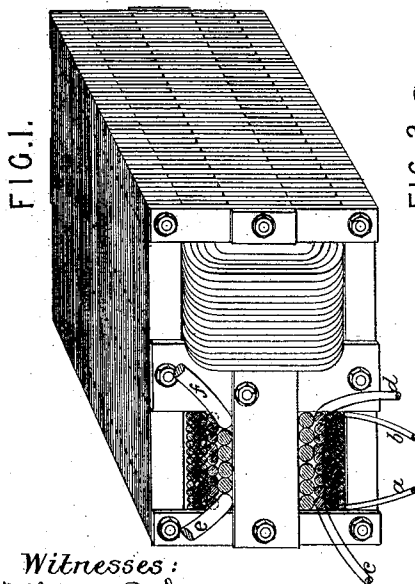


FIG. 1.

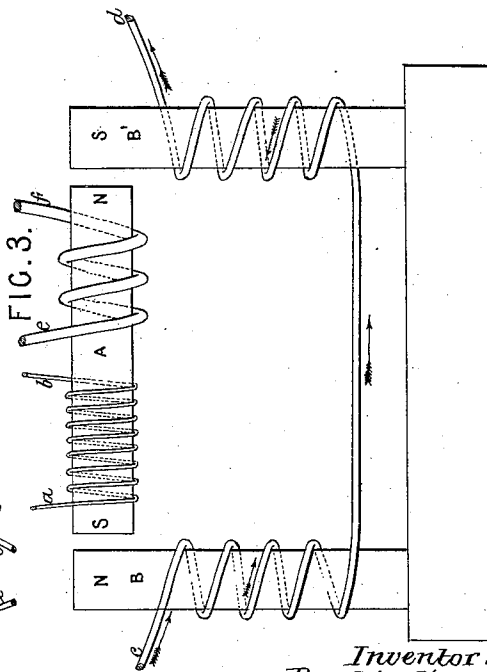


FIG. 3.

Witnesses:  
 William D. Bonner.  
 John S. Carter

Inventor:  
 Rankin Kennedy,  
 by his Attorneys,  
 Howson & Son.

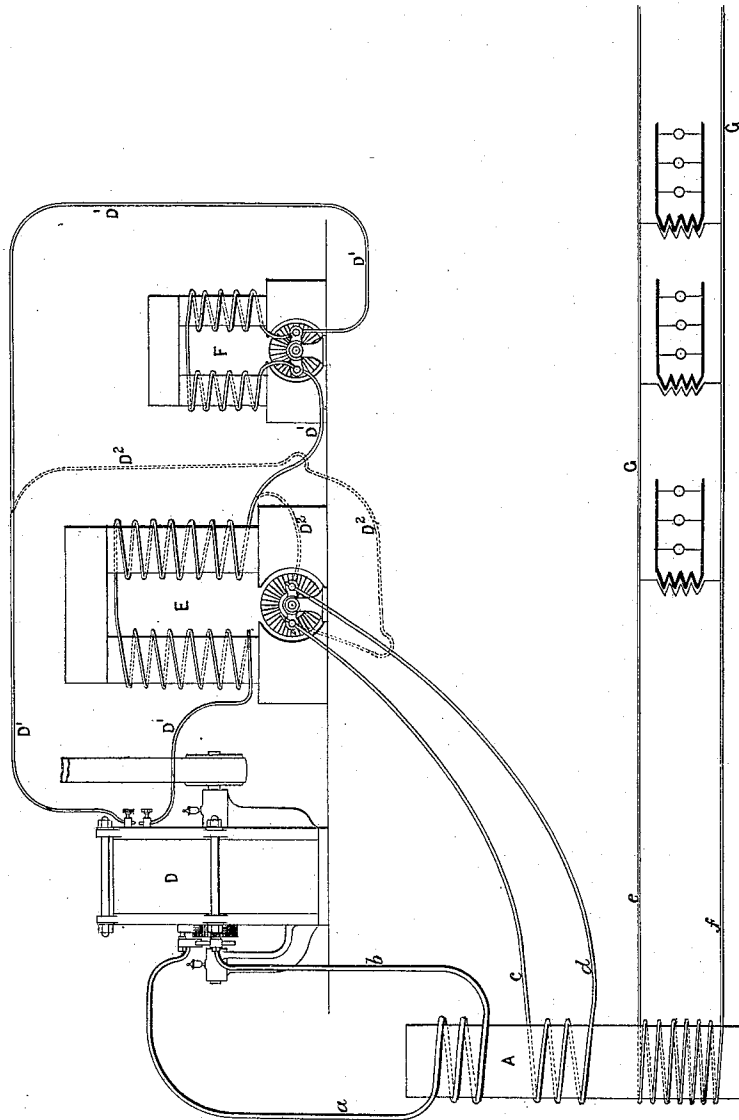
R. KENNEDY.

ALTERNATING CURRENT TRANSFORMER.

No. 378,320.

Patented Feb. 21, 1888.

FIG. 5.



Witnesses:  
William B. Bonner.  
John S. Parker.

Inventor:  
Rankin Kennedy.  
by his Attorneys.

Howson & Sons.

# UNITED STATES PATENT OFFICE.

RANKIN KENNEDY, OF GLASGOW, COUNTY OF LANARK, SCOTLAND,  
ASSIGNOR OF ONE-HALF TO ROBERT DICK, OF SAME PLACE.

## ALTERNATING-CURRENT TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 378,320, dated February 21, 1888.

Application filed April 6, 1887. Serial No. 233,837. (No model.)

*To all whom it may concern:*

Be it known that I, RANKIN KENNEDY, a subject of the Queen of Great Britain and Ireland, and a resident of Glasgow, in the county of Lanark, Scotland, have invented certain Improvements in Alternating-Current Transformers or Induction-Coils, of which the following is a specification.

In the usual forms of transformers and induction-coils for transforming alternating currents of electric energy from low potential to high potential, and from high potential to low potential, for lighting or heating purposes, the magnetic iron organ portion of the transformer is magnetized alternately in opposite directions, the flow of magnetic force is reversed in direction with every reversal of the direction of the alternating current. This reversal of the magnetism, which is very rapid, as often over two hundred reversals are made per second, consumes energy which is converted into heat in the iron, and this heat is a source of trouble and often destroys the insulation of the coils of wire in the transformers. To obviate this heating and loss of energy, according to my invention, I construct transformers in such a manner and operate them by currents of electric energy so arranged that no reversals of magnetism occur in them at all. For this purpose I wind the transformers with two circuits—a primary and a secondary—for the alternating currents, in the usual manner, and by my improvements I use a third circuit for the circulation of an independent current flowing continuously in one direction, and this continuous current has for its object the initial magnetizing of the magnetic iron organ portion of the transformer continuously in one direction. This initial magnetism may be induced in the magnetic iron organ or core of a transformer by other well-known means than by a circuit or coil of wire and a continuous-direction current of electric energy. Thus an electro-magnet or a permanent magnet may be employed as the means of giving the necessary initial magnetism to the magnetic iron organ or core.

In carrying my invention into practice I may apply my improvements with great advantage to any form or construction of induction-coil or transformer by using a third wire

or circuit, through which flows a current of electric energy in one direction. This third continuous-direction current circuit may be wound side by side either over, under, or between the two alternating-current circuits of primary and secondary wire, provided it surrounds or is surrounded by the magnetic iron organ and magnetizes that organ efficiently. The effects or working of this method of winding induction-coils or transformers I explain thus: The continuous current in the third circuit raises the iron organ of the transformer to a high degree of magnetism in one direction. The alternating current in the primary wire of the transformer alternately raises and lowers the degree of magnetism in the core or iron organ of the transformer, but never reverses that magnetism in direction. When the current in the primary wire is in the same direction as the continuous current, the magnetism in the iron organ rises in intensity. When the current in the primary wire is in the opposite direction to that in the continuous-current circuit, the magnetism in the iron organ is reduced but not reversed, and the strengths of the currents are so balanced and the number of turns in each circuit are so proportioned that the magnetism in the iron organ falls to zero, but not below it, and rises to a maximum with the alternating currents when full work is being done by the transformer.

The continuous currents may be supplied to the third-wire circuit by a continuous dynamo-electric machine or by a shunt from the generator which excites the field-magnets of the alternating-current dynamo which supplies electric energy to the primary wire in the circuit, or from other convenient source where direct currents are generated.

In the accompanying drawings, Figure 1 is a front sectional elevation in perspective of a complete transformer or induction-coil constructed in accordance with my improvements. *a b* is the primary wire, which is supplied with alternating currents of electric energy from a dynamo-electric machine or generator; *c d*, my new arrangement of wire for supplying a continuous current of electric energy, and *e f* the secondary wire or circuit of the transformer.

Fig. 2 shows a longitudinal elevation of the

magnetic iron organ portion or core A of a transformer, having coiled round it the primary wire *a b*, which may be supplied with an alternating or intermittent current of electric energy; *c d*, my new arrangement of wire, through which a continuous current is transmitted, and *ef* the secondary wire or circuit, in which an alternating current is induced.

Fig. 3 shows an elevation of the magnetic iron organ or core A of a transformer, having coiled round it the primary wire *a b* and secondary wire or circuit *ef*, and my new arrangement of third wire *c d* coiled round the pole-pieces B B' to form an electro-magnet for the purpose of acting as a conductor to prevent the reversal of the magnetism in the core A of the transformer, as in the former figures.

Fig. 4 shows an elevation of the transformer iron core A and primary and secondary conductors *a b* and *ef*, as in Fig. 3, but in which a permanent magnet, C C', is used as the conductor for preventing the reversal of the magnetism in the transformer-core A.

Fig. 5 is a general view showing my improvements applied to a practical system of distribution of electric energy in which a main transformer is used. In this arrangement, D is an alternating dynamo, E a continuous-current dynamo, and F a small separate continuous-current dynamo which excites the field-magnets of both the dynamos D and E through the wire D'. A is a main transformer, round which is coiled a primary-wire circuit, *a b*, from the commutator-brushes of the alternating dynamo D. *ef* is a secondary-wire circuit which supplies alternating currents of electric energy, induced by the primary wire *a b*, to the secondary generators and translating devices or glow lamps grouped in parallel are at G between its conductors. *c d* is my improved third-wire circuit wound round the main transformer A, and through which passes a continuous current of electric energy from the com-

mutator-brushes of the dynamo E, and this circuit *c d* prevents any reversal of the magnetism in the main transformer A.

The dotted lines D<sup>2</sup> in Fig. 5 indicate how the field-magnets of the alternating dynamo D can be excited by a current from the continuous dynamo E and my new third-wire circuit *c d* supplied with a continuous current of electric energy as a shunt from the commutator-brushes of the dynamo E, the dynamo F being not required under this arrangement.

What I claim is—

1. The combination of a generator of alternating currents with a main transformer having its core continuously magnetized in one direction, and having its primary circuit receiving an alternating current and with translating devices in its secondary circuit.

2. The combination of a generator of alternating currents and a transformer having a primary circuit receiving an alternating current, a secondary circuit, and translating devices in the latter, with a third conductor of a continuous current controlling the magnetism of the transformer-core, substantially as described.

3. A main transformer wound with primary and secondary conductors, and also with a third conductor for a continuous current, in combination with an alternating-current generator supplying an alternating current to the primary and a continuous-current generator supplying a continuous current to the third conductor, for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

RANKIN KENNEDY.

Witnesses:

W. R. M. THOMSON,

JOHN SIME.

Both of 96 Buchanan Street, Glasgow, Scotland.