(No Model.) 2 Sheets—Sheet 1.

# R. A. RIPLEY.

## ELECTRIC CURRENT CONVERTER.

No. 347,642. Patented Aug. 17, 1886.

*Fig. 1.*

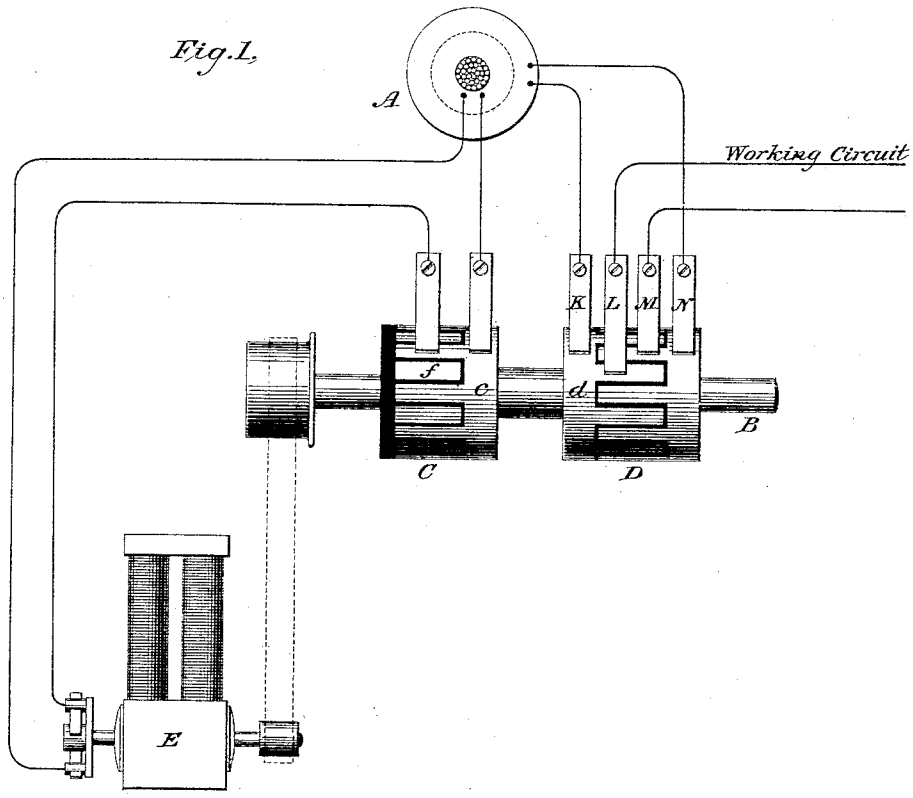
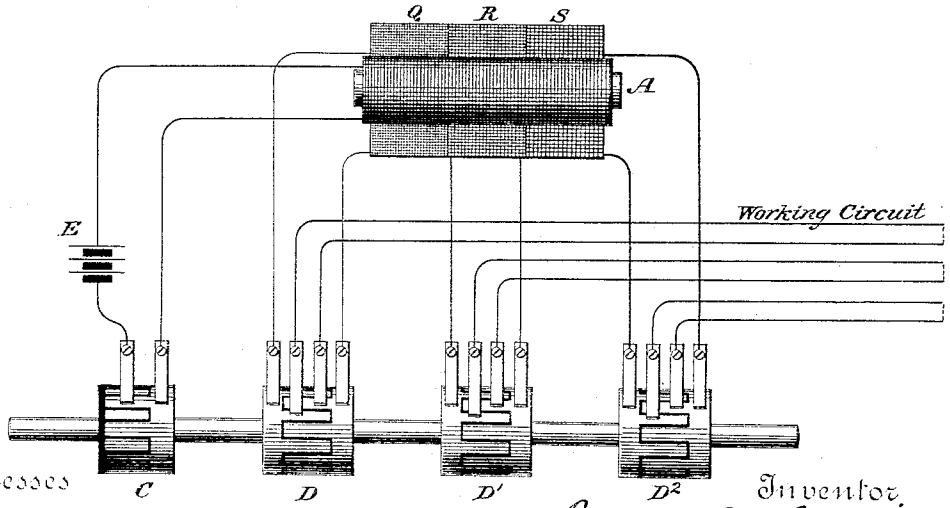



*Fig. 2.*




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(No Model.) 2 Sheets—Sheet 2.

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## ELECTRIC CURRENT CONVERTER.

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*Fig. 3.*

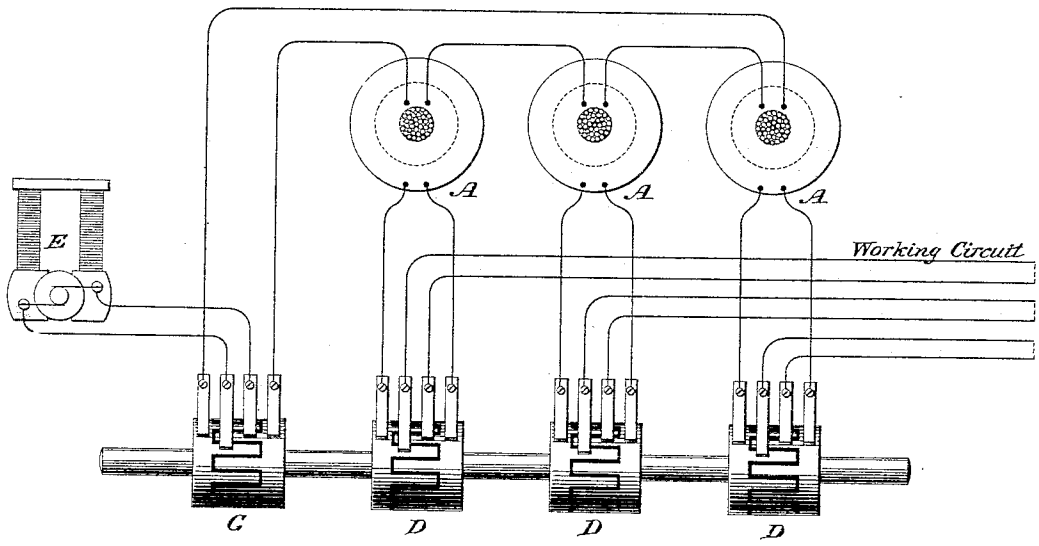
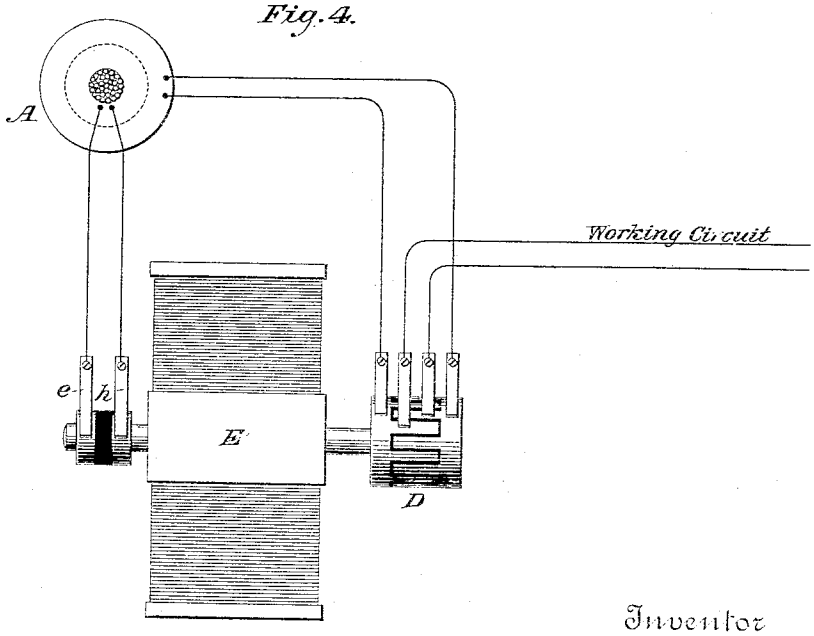



*Fig. 4.*




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# UNITED STATES PATENT OFFICE.

ROBERT A. RIPLEY, OF NEW YORK, N. Y.

## ELECTRIC-CURRENT CONVERTER.

SPECIFICATION forming part of Letters Patent No. 347,642, dated August 17, 1886.

Application filed April 10, 1885. Renewed December 16, 1885. Serial No. 185,870. (No model.)

*To all whom it may concern:*

Be it known that I, ROBERT A. RIPLEY, a citizen of the United States, residing in the city of New York, State of New York, have invented a new and useful Electric-Current Converter, of which the following is a specification.

The electric currents derived from storage-batteries, dynamo-electric machines, and other sources of electrical energy are of too low electro-motive force for many purposes, and it is desirable to convert these currents into other currents of a higher electro-motive force. On the other hand, the electro-motive force of the original current may be too high for the desired purpose, and it is required to convert it into one of lower electro-motive force. It is also desirable to be able to obtain currents of different respective electro-motive forces from the same original or primary current, as well as to obtain several independent currents of the same electro-motive force from the single primary current.

The object of my invention is to provide means for accomplishing these results; and the invention which forms the subject-matter of this patent consists, essentially, in inducing in one or more stationary coils, by means of the primary current, currents of the desired electro-motive forces, and combining with such inducing apparatus means for rectifying, with respect to the working or useful circuit, the alternating or reversed currents produced in these coils, so as to supply the working-circuits with practically-continuous currents of unchanging polarity.

For the inducing apparatus or converter I prefer to employ an apparatus similar to an induction-coil, consisting of the primary wire or coil, through which the original current is passed, and one or more secondary coils composed of finer or coarser wires, according to the respective electro-motive forces it is intended to obtain. The primary current in the primary coil, which is made to vary in strength or polarity by suitable means, induces in the secondary coils alternating currents. These alternating currents are passed through a rectifying-commutator, which operates in unison with the variations of the primary current, and rectifies the alternating secondary current produced in the coils, so as to feed the working-circuits with continuous or non-reversed currents.

My invention will be understood from the accompanying drawings, in which Figure 1 represents my converter, the primary or inducing current being obtained from the dynamo-electric machine, and the secondary current is employed to feed a single circuit. Fig. 2 represents a modification of my invention, in which I employ a number of independent secondary coils to feed the independent circuits with currents of different electro-motive forces, the primary or inducing coil being common to all the secondary coils, and the source of current shown in this case being a battery of any desired form. Fig. 3 represents another modification of my invention, in which independent converters or inducing apparatuses are employed, and are fed by the same primary current which is derived from a continuous-current dynamo-machine, and converted into an alternating current by an additional commutator. Fig. 4 represents an alternating-current dynamo-machine employed to feed the primary circuit, and the secondary current is rectified by a commutator carried upon the shaft of the dynamo and constructed to reverse the secondary current synchronously with the reversals of the primary current in the dynamo.

In Fig. 1, A represents my inducing apparatus or converter, which may be constructed in any desired form; but I have shown it as consisting, generally, of the ordinary core, the primary wire wound thereon, and the secondary wire of an induction-coil, the respective sizes of the wires and the form of the coils being of course adapted to the particular conditions of any case. B is a shaft capable of being revolved at the proper speed and carrying two commutators, C and D. It may be driven in any desired way—by connection to the generating-dynamo E by belt, as represented, for example, if desirable; but it is not necessary in this form of construction that its speed should bear any particular relation to that of the dynamo. The commutator C is interposed in the circuit of the dynamo E, which leads through the primary circuit of the converter A, and consists simply of consecutive metal strips, of which the alternate ones form part of or are connected to the continuous ring *c*, and the

intermediate ones are dead-strips, serving merely as metal surfaces to support the left-hand brush between the adjoining sections. When this commutator is caused to revolve, the primary circuit is broken every time one of the dead-strips *f* passes under its brush, and is closed while one of the adjoining strips is passing under the same brush, so that this commutator operates to make and break the circuit intermittently at a rate corresponding to its speed of revolution. The commutator D is made similar to the commutator C, except that it is provided with four brushes, as shown, and both halves are alike—that is, what act as dead-strips *f* in the commutator C form part of or are connected to the left-hand ring D, with which the brush K connects. The brush L is set with a "lead" of one commutator-strip in advance of the brush M, and these two brushes form the terminals of the working-circuit. The reversed or alternating current produced by the variation or making and breaking of the primary current from the dynamo passes to the outside brushes, K and N, and thence through the commutator D to the brushes L and M, and thence through the working-circuit. The commutator D is provided with the same number of strips as the commutator C, and is shown in the drawings as being set upon the shaft, so that its strips exactly correspond in position with respect to its brushes with those of the commutator C, though in practice one will probably require to be set with a slight lead in advance of the other, on account of the retardation that may take place in the converter A. This, however, would depend upon the particular conditions, and can very easily be found in any case by experiment. The effect of this construction is, that the instant the commutator C breaks or opens the circuit and the current is reversed in the secondary circuit the commutator D acts to reverse the secondary coil with respect to the working-circuit, so that the secondary circuits, though alternating in the converter, are rectified—that is, are made to pass through the working-circuit in the same direction. When the commutator C acts to close the primary circuit, the current traversing the primary coil produces two effects. It acts to a certain extent directly upon the secondary coil and induces a current therein, and this induced current reacts upon the primary coil and sets up therein an opposing or counter electro-motive force, which results in an absorption of the primary current. The principal effect of the primary coil, however, is to strain the iron core into a magnetic condition. This results in two effects. The magnetic core reacts while being magnetized upon the primary coil and generates a counter electro-motive force, resulting in a further absorption of the primary current, and at the same time the magnetization of the core generates a current in the secondary coil, and this current also reacts on the primary coil and neutralizes the current therein. In this way the current traversing the primary coil on closing produces an induced current of one polarity in the secondary coil. When the commutator C opens the circuit again, the energy stored up in the core during the magnetization is given out in the form of a reversed induced current in the secondary coil as the core returns to its unmagnetic condition. Before this current is produced, however, the secondary coil has been reversed by the commutator D in the secondary circuit, so that this last current traverses the actual working-circuit in the same direction as the current produced by the closing of the primary circuit. In order that the iron core may magnetize and demagnetize with sufficient rapidity, it should be made of well-annealed iron and formed of a bundle of iron wires, or of sheets or laminæ insulated to prevent the formation of Foucault currents, in the well-known manner.

In Fig. 2, A represents the converter, as before. The secondary or inducing coil is divided up into any desired number of sections, three, Q, R, and S, being shown. The primary circuit of the converter is fed, as before, from any desired source of current, E, a storage-battery, or any other form of battery, as shown, and an intermittent current is produced by means of the commutator C, as before. The first coil, Q, of the secondary I have represented as composed of comparatively fine wire, in order to obtain a comparatively higher electro-motive force. The circuit from this leads to the rectifying-commutator D, as before, from which the corresponding working-circuit is fed. The second coil or section, R, I have represented as composed of somewhat coarser wire, or fewer convolutions, and leads to the commutator D′, which, as before, rectifies the alternating currents thus obtained with respect to the second working-circuit, giving a continuous current of somewhat lower electro-motive force. The third section, S, is composed of still larger wire, or fewer turns, if preferred, and leads to the third commutator, $D^2$, which feeds the third working-circuit, as clearly represented. By this construction I am enabled to obtain any desired number of currents in separate circuits entirely independent of each other and of any desired electro-motive forces, and these currents may be employed to operate a number of independent telegraph-circuits, or for any other purposes.

In Fig. 3, A A A represent separate converters. I have shown their primary coils as connected in series and supplied from the same source of current, E. If a continuous-current dynamo-machine be employed, a higher efficiency can be obtained by reversing or alternating the current in such a machine in the primary coils than if the primary circuits be similarly made and broken intermittently; and in this case I employ a reversing-commutator, G, through which the current from the source E is passed. It converts the continuous current from the source, as is evident from

the drawings, into an alternating current, and as it is carried upon the same shaft as the rectifying-commutators D, each of which is provided with a corresponding number of strips, it acts to alternate the primary current in unison with the rectifying-commutators D, and if the commutator-brushes are properly adjusted and the commutators revolved at the proper speed the effect in the working-circuits derived from the secondary coils will be practically continuous currents of the desired electro-motive forces and entirely independent of one another.

Instead of employing a continuous-current source of electrical energy, E, an alternating-current dynamo-machine may be used, and this construction I have illustrated in Fig. 4. E represents an alternating-current dynamo of any well-known form, the current being taken off by the brushes *e* and *h*, which bear, respectively, upon two continuous connecting-rings, as shown, no commutator being employed in this machine upon the shaft. Upon the shaft of this machine is mounted a rectifying-commutator, D, such as I have already described, and it is constructed so that its strips or sections correspond in number and relative positions upon the shaft with the bobbins or sections of the armature winding, which determine the number of reversals in the current per revolution of the shaft. The consequence is, that the commutator D operates in unison with the reversals of current in the armature and rectifies the alternating current thereby produced in the secondary circuit, producing in the working-circuit a practically continuous current of unvarying strength, if properly constructed, and of whatever electro-motive force it is desired to obtain. If the electro-motive force of the primary circuit or source of current is too high, the secondary circuit should then be wound with coarser wire or fewer turns, and the effect will be a reduction in the electro-motive force.

I am aware that it has been proposed to convert high-tension currents into low-tension currents by causing such high-tension current to pass through an inducing apparatus or coil alternately in opposite directions, and synchronously rectifying the induced current thereby generated, so as to supply the consumption or working circuit with a continuous current, such an apparatus being described in patent to Edison, No. 278,418, of May 29, 1883, and I do not broadly claim such apparatus.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination of an electric generator or source of electric current, means for reversing or producing an intermittent change in the current derived therefrom, a primary or inducing circuit or conductor fed by the said current, two or more secondary or induced coils or conductors under the inductive influence of the said primary circuit, and two or more rectifying-commutators respectively connected with the separate secondary coils and their working-circuits, whereby two or more separate continuous currents are obtained from the same primary current.

2. The combination of an electric generator or source of electric current, means for reversing or producing an intermittent change in the current derived therefrom, a primary coil or conductor wound upon a magnetic core and fed by the said current, two or more secondary coils or conductors, also wound upon the said core, and two or more rectifying-commutators respectively connected with the separate secondary coils and their working-circuits, so as to rectify the currents generated therein.

3. The combination of an electric generator or source of electric current, means for reversing or producing an intermittent change in the current derived therefrom, a primary coil or conductor wound upon a magnetic core and fed by the said current, two or more secondary coils or conductors composed of different respective numbers of convolutions, also wound upon the said core, and two or more rectifying-commutators respectively connected with the secondary coils and their working-circuits, so as to rectify the currents generated therein.

4. The combination of an alternating-current dynamo-electric machine, a primary coil or conductor fed thereby, a secondary coil or conductor under the inductive influence of the primary coil, and a rectifying-commutator carried by the shaft of the dynamo-machine, and so constructed with respect to the armature coils or sections of said machine as to reverse the secondary coil in circuit synchronously with the reversals of the primary current.

Signed this 8th day of April, 1885.

ROBERT A. RIPLEY.

Witnesses:
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