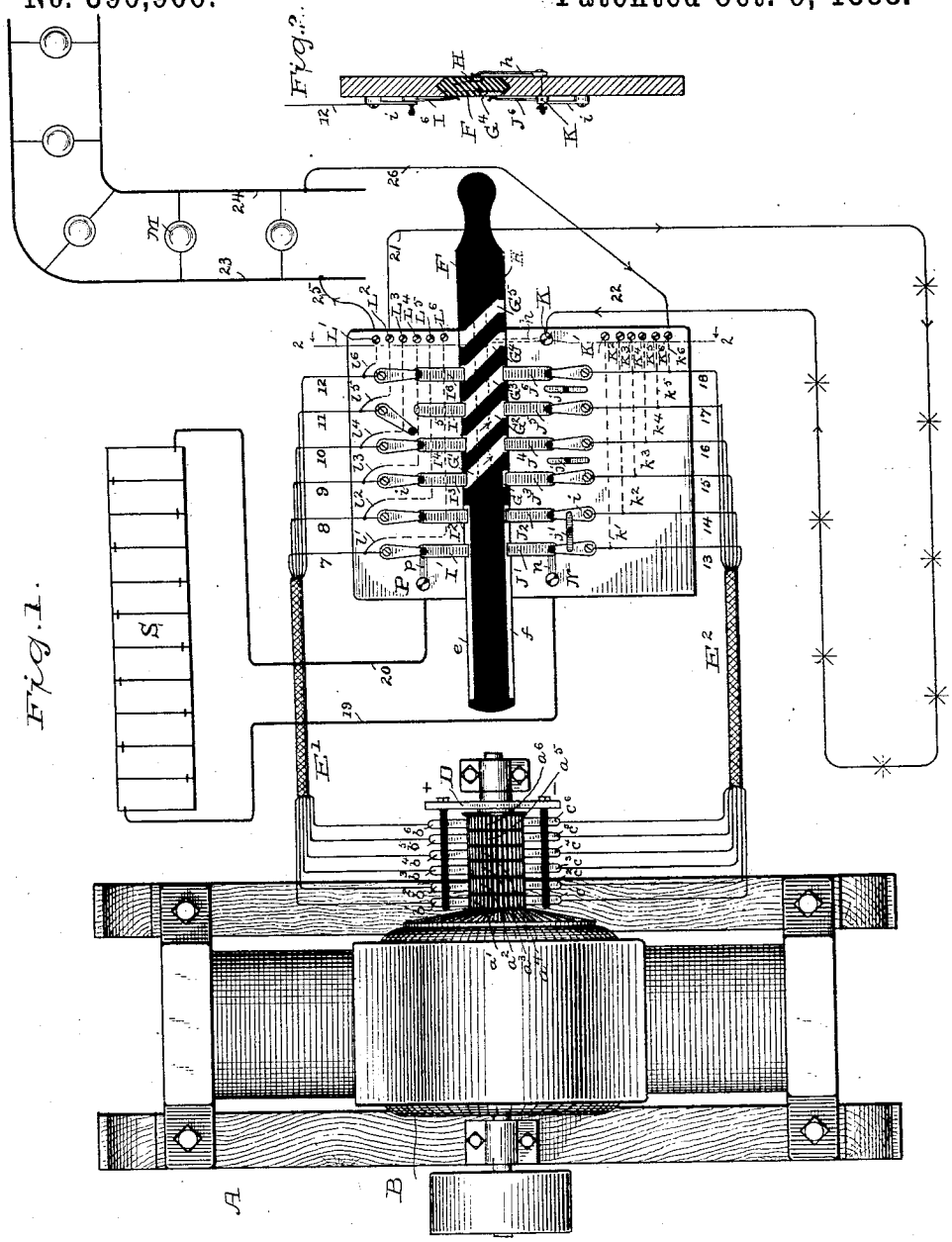
(No Model.) 2 Sheets—Sheet 1.

# E. E. RIES.

## MULTIPLE CURRENT ELECTRIC GENERATOR.

No. 390,906. Patented Oct. 9, 1888.



Witnesses,
H. A. Lamb.
Stephen D. Jamus.

Inventor,
Elias E. Ries.
By his Attorney
Frankland Jamus.

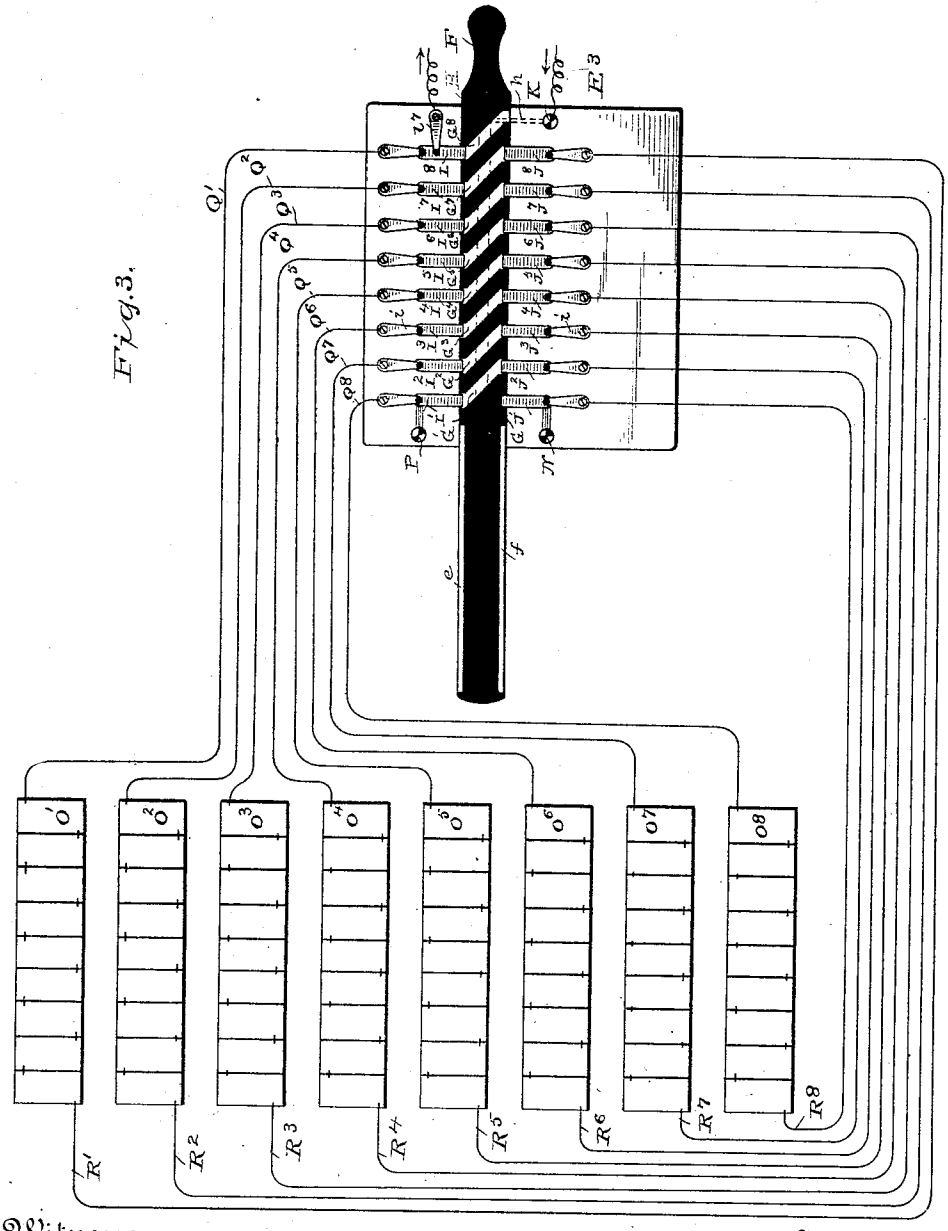
(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.



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Inventor,
Elias E. Ries.
By his Attorney
Frankland Jamus.

# UNITED STATES PATENT OFFICE.

ELIAS E. RIES, OF BALTIMORE, MARYLAND, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO RIES & HENDERSON, OF SAME PLACE.

## MULTIPLE-CURRENT ELECTRIC GENERATOR.

SPECIFICATION forming part of Letters Patent No. 390,906, dated October 9, 1888.

Application filed July 22, 1887. Serial No. 244,977. (No model.)

*To all whom it may concern:*

Be it known that I, ELIAS E. RIES, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Multiple-Current Electric Generators and Switches, of which the following is a description.

My present invention relates to improvements in apparatus for generating, combining, and distributing electric currents, and it has reference more particularly to the construction and arrangement of apparatus designed and adapted to generate or furnish a plurality of separate currents, each capable of supplying a separate circuit, but arranged to be grouped in various ways for furnishing current of any desired character to one or more working-circuits.

The invention comprises, primarily, a source of electricity—such as a dynamo-electric machine, secondary battery, or other generator—so arranged and organized as to furnish a multiple or divisible current, the separate portions of which are preferably of equal electromotive force or otherwise interchangeable.

It comprises, secondly, a suitable arrangement of switching apparatus—such as hereinafter more fully described—for combining, grouping, and distributing the current or currents into one or more circuits and permit of obtaining varying electrical effects therein.

The invention further comprises certain other features and details of construction that will be more fully referred to hereinafter.

In carrying out my invention I have illustrated as one form of generator a dynamo-electric machine the armature-windings of which are so arranged that each armature-section will be composed of the desired number of separately-insulated coils—for example, in the present instance, six—the six separately-insulated wires being combined in any convenient manner for convenience in winding, their terminals being separated and each terminal separately connected to a division of the commutator, which latter is divided into six separate portions. In connection with the divisible armature and divided commutator is provided a switch of novel design, to the terminals of which are led the connections extending from the separate sets of commutator-brushes, by means of which any conceivable combinations of the separate windings can be made. As shown, the switch is arranged to connect the switch-brushes, and thereby two of the commutators, in parallel, so as to unite their currents and reduce its tension for charging a storage-battery. The succeeding three commutators are connected in series, so as to increase the tension of the current, which is shown as feeding a circuit of arc lamps. The remaining section is separately connected to a circuit containing incandescent lamps or motors. As will be understood from the description to follow, the switch is so constructed that by simple movements the connections shown can be changed—as, for example, all the commutators can be united in parallel. All of them may be connected in series. Any two may be in series; or, as shown, part may be in parallel, part in series, and part separately connected, as will be fully hereinafter described. The advantages of such a construction will be apparent, inasmuch as by means thereof one generator may be arranged to produce almost any effects within the limits of a dynamo-electric machine. A generator the armature of which is divisible, as explained, may be by a slight manipulation of the switch changed into a machine producing currents of the highest tension, and by another equally simple change may be transformed into a generator of currents of the lowest tension, and it will readily be understood how all intermediate effects may be produced by means of my invention.

The capabilities of the device just described are very great, and from the foregoing it will be understood how the various changes and connections desired under varying conditions can be effected, thus enabling users of electricity to reduce the number of generators maintained at a single point, and, among other advantages, permitting them to change an arc lighting-machine into an incandescent lighting-machine; or to operate both arc and incandescent through the same generator by so combining and arranging the separable portions of a divisible armature by means of my improved switch as to produce the desired electrical conditions and combinations.

In the accompanying drawings, Figure 1 is

a plan view of a generator and switch embodying my invention, together with various electric circuits, the circuits being shown in connection therewith diagrammatically. Fig. 2 is a sectional view of the switch-board on the line 2 2 of Fig. 1. Fig. 3 shows an arrangement of the switch as applied to a group of secondary batteries instead of a dynamo-electric generator.

Similar letters denote like parts throughout.

A is a dynamo-electric generator, of which B is the armature, both of which may be of any type of continuous-current machines. The armature B is provided with a commutator divided into six portions, $a' a^2 a^3 a^4 a^5 a^6$, each insulated from the other. The positive commutator-brushes are shown at $b' b^2 b^3 b^4 b^5 b^6$, and $c' c^2 c^3 c^4 c^5 c^6$ are the negative commutator-brushes therefor, both of which are suitably mounted upon a radially-adjustable yoke, D, from which they are properly insulated.

E is a switch-board, which is provided, preferably, at about its central portion with a sliding switch, F. The slide F is provided at one end with long continuous conducting-plates $e f$, and along its remaining portion with a series of—in this instance five—strips of conducting metal, $G' G^2 G^3 G^4 G^5$, which extend from one edge of the side obliquely across to its opposite edge; and it is also provided with a conducting-strip, H, at its under side, said strip H being connected with a terminal, G, which is of the same width as and located directly opposite to the positive end of the cross-strip G'.

Upon one side of the board E are located a series of six stationary brushes, which I have called "switch-brushes," $I' I^2 I^3 I^4 I^5 I^6$, representing the positive commutator-brushes $b' b^2 b^3 b^4 b^5 b^6$, and connected thereto by conductors 7 8 9 10 11 12, which, for convenience, are grouped in the form of a cable, E', extending between the commutators and the switch-board, which latter may, for convenience, be placed in almost any position with respect to the generator, secondary batteries, or other source of electricity.

The negative commutator-brushes are represented by switch-brushes $J' J^2 J^3 J^4 J^5 J^6$, being connected with said negative brushes by conductors 13 14 15 16 17 18 and cable $E^2$. Between the actual extremities of the conductors 7 to 18 are placed manual switches $i$, by means of which any one of the commutators, its armature, conductor, and switch-brushes may be cut out of circuit and rendered inoperative. Additional cross-switches $j j'$ are provided, by means of which the commutator-conductors may be joined in pairs when, for instance, it is desired to combine the end pairs through the switch and to form a combination with the middle pair separate from those completed through the connections on the switch. The two sets of switch-brushes I, &c., J, &c., are placed at regular intervals upon the switch-board, the positive switch-brushes I' being opposite to the negative switch-brushes J', and so on throughout the series. The continuous conducting-strips $e$ and $f$ on the switch F are located along the edge of said switch, so that the brushes bear upon them, and the said strips are of such a length that when that end of the switch is drawn into position all of the brushes of each set will bear upon their respective strips and be thereby connected in parallel circuit.

The cross-strips $G' G^2 G^3 G^4 G^5$ are located so that the positive end of the first one is the same distance from the inner end of the parallel strip E as the distance between any one of the brushes extending from that point diagonally across the switch F and terminating at a point twice that distance from the inner end of the parallel strip $f$, so that from the wire 9 the current will be carried obliquely across the switch and into the brush 16, instead of into the brush 15, which is opposite thereto.

The strips $G' G^2 G^3 G^4 G^5$ are all similar to the one just described, and, being equidistant upon the switch F, will make contact with any desired one or more of the switch-brushes as the said switch is moved in or out upon the board. The space opposite to the switch-brush 15 in Fig. 1, and equidistant between the inner end of the parallel strip $f$ and the negative end of the cross-strip G', is occupied by the terminal G of the series return-connection H, which is a strip of conducting metal placed for convenience at the lower side of the switch L, where it is thoroughly insulated from all the other strips, but in electrical contact with a spring-brush, $h$, extending from binding-post K.

The positive conductors 7 8 9 10 11 12 are each in direct connection with separate binding-posts $L' L^2 L^3 L^4 L^5 L^6$, to which they are connected by permanent wires $l' l^2 l^3 l^4 l^5 l^6$, the negative side being similarly provided with binding-posts $K' K^2 K^3 K^4 K^5 K^6$ and branch conductors $k' k^2 k^3 k^4 k^5 k^6$. As shown in Fig. 1, the position of the switch F is such that the first two pairs of commutator-brushes are connected in parallel, since they both rest upon the parallel strips $e f$, the current therefrom being thereby increased in volume and taken off to storage-battery S by conductors 19 20, extending from binding-posts P N, which are connected by suitable conductors, $p n$, with the switch-brushes I' J'. The three following sets of switch-brushes, representing commutators $a^3 a^4 a^5$, with their respective armature-circuits, are connected in series so as to combine the electro-motive force of all three sections to produce a current suitable for arc-lighting, the series connections being established by means of the oblique conducting-strips $G' G^2$, the connections being as follows: From binding-post $L^2$ to circuit by conductor 21, returning by conductor 22 to binding-post K, thence by spring $h$ to series return-strip H, from the terminal G thereof into switch-brush $J^3$, thence by conductor 15 to commutator $a^3$, issuing therefrom by brush $b^3$, thence by conductor 9, brush $I^3$, strip G', brush $J^4$, conductor 16, to commutator $a^4$, issuing by brush $b^4$, passing thence

by conductor 10, brush $I^4$, strip $G^2$, brush $J^5$, and conductor 17 to commutator $a^5$, issuing thence by brush $b^5$ and passing through conductor 11 and auxiliary conductor 15 to the binding-post $L^2$. The switch-terminals of the remaining commutator are connected to operate a separate circuit between the conductors 23 and 24, in which may be connected motors M or incandescent lamps or other translating devices for which the current supplied is suitable, the connections to said circuit being from binding-post L' by conductor 25 to main 23, through translating devices M to main 24, thence by wire 26 to binding-post $K^6$, thence by branch wire $k^6$ and conductor 18 to commutator $a^6$, to conductor 12, and by branch wire $l^6$ back to binding-post L'.

In Fig. 3, O' $O^2$ $O^3$ $O^4$ $O^5$ $O^6$ $O^7$ $O^8$ are storage-batteries, and $E^3$ is a switch-board similar to the one just described, except that it is provided with eight sets of contacts and connections instead of the six heretofore described, being shown as arranged in connection with a series of storage batteries for the purpose of charging said batteries in parallel and discharging them in series, where a low-tension charging-current only is available, or for the purpose of charging in series and discharging in parallel in cases where high-tension charging-currents are employed. This latter feature is of importance where the charging-current is transmitted at a high electro-motive force from a distant generating-station to secondary batteries at one or more points of consumption or distribution, at which latter the stored high-tension current is to be transformed or fed into one or more working-circuits at a lower electro-motive force suited to the particular requirements of each circuit. It will be apparent that by the arrangement of battery-sections and switch-board herein shown this can be readily and conveniently accomplished. Several of the details of the switch-board E are omitted from the switch-board $E^3$, for convenience only, it being understood that the switch-board E, with all its connections, could be substituted therefor. The battery O' is connected with its positive switch-brush $I^8$ and with its negative switch-brush $J^8$ by the conductor R', the series connections being made by means of the oblique strips G' $G^2$ $G^3$ $G^4$ $G^5$ $G^6$ $G^7$ $G^8$ precisely as heretofore described; and when the battery-sections are to be connected in parallel order, whether for charging or discharging, connection is made with the exterior circuit through the binding posts P N and conductors $p$ $n$, the parallel strips $e$ $f$ of the switch being then brought into contact with the entire series of switch-brushes to connect them all in multiple arc.

From the description already given it will be readily understood that any desired portion of the group of batteries may be connected to the working-circuit or to the charging-circuit at will; and by means of my improved switch and connections I am enabled to carry on the charging and discharging at one and the same time without interference throughout, rendering the plant capable of the greatest possible use.

What I have called the series return-connection H might directly be dispensed with by connecting the return-wire to that one of the binding-posts K' $K^2$ $K^3$ $K^4$ $K^5$ $K^6$ representing the switch-brush resting upon the terminal G; but I find said connection extremely useful in case it is desired to alter the connections of the interior portions without affecting those at each end. For example, with the switch F in the position shown—having first opened the switch $j'$ by a simple movement—I could increase the electro-motive force of the arc circuit by cutting in an additional set of brushes and connections $I^2$ $J^3$, thereby dividing the current previously flowing into the storage battery. The opposite effect could be produced by drawing the slide F one space forward, throwing three divisions into the storage battery and reducing the series connections to two.

The cross switches $j$ are for the purpose of permitting the grouping of different portions of the switch to form separate parallel circuits, only one of which could pass through the switch F. Further combinations may also be made by turning switches $i$ parallel with the switch F and into contact with adjoining circuit in either direction.

The form illustrated is necessarily diagrammatic; but it will be understood that, although specifically described, I do not limit myself to the precise details of arrangement and construction shown, as they may be varied and modified in many instances without departing from the spirit of the invention.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination of an armature-core provided with a series of independent conductors, a separate commutator for each conductor, a plurality of exterior working-circuits, and means, consisting of a movable switch and connections between the switch and the respective sets of commutator-brushes, for connecting said armature-conductors in said exterior working-circuits, either in series or multiple arc, as may be desired, substantially as described.

2. The combination, with a single armature having divided winding, of a separate commutator for each of said windings, a plurality of consumption-circuits, and a single switch for uniting any desired portion of said divided winding, and connecting the same in the desired consumption circuit or circuits, substantially as described.

3. The combination, with separate sources of electricity, of a switch having oppositely-placed switch-brushes, and representing said sources, positive and negative binding-posts connected to said brushes, and a movable switch provided with parallel and oblique

conducting-strips arranged thereon in the path of the said switch-brushes and adapted to be placed in contact with and to electrically connect or bridge more or fewer of said brushes, whereby any desired portion thereof may be connected in parallel, the remaining being in series, substantially as described.

4. The combination, with a divided commutator, of a switch board having stationary switch-brushes representing the divisions of the commutator, conductors extending from said separate commutators to switches bearing upon the switch-brushes, separate branch wires extending from each of said conductors to separate binding-posts, and movable switching devices interposed between the switch-brushes and carrying parallel and oblique conducting-strips arranged to electrically connect or bridge any desired brushes, whereby a portion of the brushes may be connected in parallel, a portion in series, and a portion independently thereof, substantially as described.

5. The combination of an armature for electric generators, comprising a single core wound with separately-insulated conductors, a divided commutator representing said separate windings, a switch-board having stationary switch-brushes representing said separate commutators, consumption-circuits of different resistances and character connected to said switch-board, and a switching device between the brushes thereof for combining the separate currents to produce currents of the electromotive force and intensity required by the separate circuits, substantially as described.

6. The combination, with the generator having divisible armature-windings and a multiple commutator, of the switch-board having divisible brushes representing the multiple commutator, the sliding switch F, interposed between said brushes and provided at one extremity with parallel conducting-strips arranged to connect two or more of said brushes in multiple arc, and also at the other end with oblique conducting-strips G', &c., arranged to connect any two or more of said switch-brushes and connections in series, substantially as described.

7. The combination, with a generator having divisible armature-windings and a multiple commutator, of the switch-board having switch-brushes representing the multiple commutator and connected thereto by suitable conductors, the sliding switch F, interposed between said brushes and provided with the oblique conducting-strips G', &c., and the return-strip H, and terminal G, substantially as described.

8. The combination, with suitable charging and consumption-circuits, of a secondary battery divided into sections, and a switch provided with terminals for each section of the battery and arranged to progressively connect said sections in parallel order when the switch is moved in one direction, and in series order when moved in the opposite or reverse direction, substantially as described.

9. The combination, with two separate circuits supplied with current from a source of electricity furnishing multiple or divided currents which are substantially equal, of a switch in circuit with said source and with both of said circuits, and arranged and adapted to variably distribute the current between the two circuits in such a manner that the electromotive force rises in the one as the current is diminished in the other, and vice versa.

10. The combination, with separate sources of electricity furnishing currents at substantially equal differences of potential, of a switch provided with a pair of terminals for each separate source of current, and having a sliding or other movable portion arranged to make contact with more or less of said pairs of terminals, and thereby consecutively connect the whole or any desired number of said sources of current in series, in parallel, or part in series and part in parallel, the arrangement being such that in moving the switch each successive pair of terminals, and consequently the source of current represented by them, is consecutively transferred from the series and added to the parallel group, and vice versa, according as the movable portion of the switch is moved in one or the other direction, substantially as described.

11. The combination of a source or sources of electricity furnishing a plurality of currents, a switch provided with terminals for each current or source of current, and having a sliding or other movable portion designed and arranged to connect the said sources of current or a portion thereof in parallel or series with one or more working-circuits, and a number of additional independent switches, also in connection with the said terminals, by means of which electrical connection may be independently established between one or more individual sources of current and an exterior circuit or circuits irrespective of the position of the sliding or movable portion of the switch or the circuit connections established thereby, substantially as described.

In testimony whereof I hereto affix my signature in presence of two witnesses.

ELIAS E. RIES.

Witnesses:
FRANKLAND JANNUS,
JNO. T. MADDOX.