

Date of Application, 1st May, 1888
Specification Accepted, 1st June, 1888

~~~~~  
A.D. 1888, 1st MAY. N° 6502.  
~~~~~

COMPLETE SPECIFICATION.

[Communicated from abroad by NIKOLA TESLA, of the City and State of New York,
United States of America, Electrician.]

**Improvements relating to the Generation and Distribution of Electric
Currents and to Apparatus therefor.**

I, HENRY HARRIS LAKE, of the firm of Haseltine, Lake & Co., Patent Agents, Southampton Buildings in the County of Middlesex, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to those systems of electrical distribution in which a current from a single source of supply in a main or transmitting circuit, is caused to induce, by means of suitable induction coils, a current or currents in an independent working circuit or circuits.

The main objects of the invention are the same as have heretofore been obtained by the use of these systems, *viz.* : To divide the current from a single source whereby a number of lamps, motors or other translating devices may be independently controlled and operated by the same source of current, and in some cases to reduce a current of high potential in the main circuit to one of greater quantity and lower potential in the independent consumption circuit or circuits.

The general character of these devices is now well understood. An alternating current magneto machine is used as the source of supply. The current developed thereby is conducted through a transmission circuit to one or more distant points at which the transformers are located. These consist of induction machines of various kinds ; in some cases ordinary forms of induction coil have been used, with one of the coils in the transmitting circuit and the other in a local or consumption circuit, the coils being differently proportioned according to the work to be done in the consumption circuit. That is to say, if the work requires a current of higher potential than that in the transmission circuit the secondary or induced coil is of greater length and resistance than the primary ; while on the other hand, if a quantity current of lower potential is wanted the longer coil is made the primary.

Lake's Improvements relating to the Generation & Distribution of Electric Currents, &c.

In lieu of these devices various forms of electro-dynamic induction machines, including the combined motors and generators have been devised. For instance, a motor is constructed in accordance with well understood principles and on the same armature are wound induced coils which constitute the generator. The motor coils are generally of fine wire and the generator coils of coarser wire so as to produce a current of greater quantity and lower potential than the line current which is of relatively high potential to avoid loss in long transmission. A similar arrangement is to wind coils corresponding to those described on a ring or similar core and by means of a commutator of suitable kind to direct the current through the inducing coils successively so as to maintain a movement of the poles of the core and of the lines of force which set up the currents in the induced coils.

Without enumerating the objections to these systems in detail, it will suffice to say that the theory or the principle of the action or operation of these devices has apparently been so little understood that their proper construction and use has, up to the present time been attended with various difficulties and great expense. Transformers are very liable to be injured and burnt out, and the means resorted to for curing this and other defects have invariably been at the expense of efficiency.

This invention comprises a method of and apparatus for the conversion and distribution of electrical energy which is not subject to the objections above alluded to and which is both efficient and safe. The result is obtained through a conversion by true dynamic induction under highly efficient conditions, and without the use of expensive or complicated apparatus or moving devices, which in use are liable to wear out or require attention.

This method consists in progressively and continuously shifting the line or points of maximum effect in an inductive field across the convolutions of a coil or conductor within the influence of said field and included in or forming part of a secondary or working circuit.

For carrying out this invention a series of inducing coils and corresponding induced coils is provided, which, by preference are wound upon a core closed upon itself. Such a core, for instance, as is used in the Grammetype of dynamo-machine. The two sets of coils are wound upon this core side by side or superposed, or otherwise placed in well-known ways to bring them into the most effective relations to one another and to the core.

The inducing or primary coils wound on the core are divided into pairs or sets, and they are so connected electrically that while the coils of one pair or set co-operate in fixing the magnetic poles of the core at two given diametrically opposite points, the coils of the other pair or set—assuming for the sake of illustration that there are but two—tend to fix the poles at ninety degrees from such points.

With this induction device or converter an alternating current generator is used with coils or sets of coils to correspond with those of the converter and by means of suitable conductors the corresponding coils of the generator and converter are connected up in independent circuits. It results from this that the different electrical phases in the generator are attended by corresponding magnetic changes in the converter or in other words, that as the generator coils revolve, the points of greatest magnetic intensity in the converter will be progressively shifted or whirled around. This principle of operation may be variously modified and applied to the operation of electro-magnetic motors and the various conditions under which it may be so applied will suggest modifications in the present system. The intention herein, therefore, is merely to describe the best and the most convenient manner for carrying out the invention as applied to a system of electrical distribution. It will be understood that the form of both the generator and converter may be very greatly modified.

In illustration of the details of construction which the invention involves, reference is made to the accompanying drawings. The Figure being a diagram of the converter and the generator with their proper electrical connections.

A is a core which is closed upon itself, that is to say, it is of an annular, cylindrical or equivalent form; and as the efficiency of the apparatus is largely increased by the subdivision of this core it is made of thin strips plates or wires of soft iron electrically

Lake's Improvements relating to the Generation & Distribution of Electric Currents, &c.

insulated from one another as far as practicable. Upon this core by any well known method are wound, for example, four coils $BB B^1 B^1$ which constitute the primary coils and which are composed of long lengths of comparatively fine wire. Over these coils shorter coils of coarser wire $CC C^1 C^1$ are wound which constitute the induced or secondary coils. The construction of this or any equivalent form of converter may be carried further by enclosing these coils with iron as, for example, by winding over the coils a layer or layers of insulated iron wire.

The device is provided with suitable binding posts to which the ends of the coils are connected. The diametrically opposite coils BB and $B^1 B^1$ are connected respectively in series and the four terminals are connected to the binding posts. The induced coils are connected together in any desired manner. For example, coils CC may be connected in multiple arc when a quantity current is desired, as for running a group of incandescent lamps D , while $C^1 C^1$ may be independently connected in series in a circuit including arc lamps or the like.

The generator in this system will be adapted to the converter in the manner illustrated. For example, in the present case it consists of a pair of ordinary permanent or electro-magnets EE , between which a cylindrical armature core is mounted on a shaft F and wound with two coils GG^1 . The terminals of these coils are connected respectively to four insulated or collecting rings $HH H^1 H^1$ and the four line circuit wires L connect the brushes K bearing on these rings to the converter in the order shown.

Noting the results of this combination it will be observed that at a given point of time the coil G is in its neutral position and is generating little or no current, while the other coil G^1 is in a position where it exerts its maximum effect. Assuming coil G to be connected in circuit with coils BB of the converter and coil G^1 with coils $B^1 B^1$ it is evident that the poles of the ring A at such point of time will be determined by the current in coils $B^1 B^1$ alone. But as the armature of the generator revolves coil G develops more current and coil G^1 less, until G reaches its maximum and G^1 its neutral position.

The obvious result will be to shift the poles of the ring A through one quarter of its periphery. The movement of the coils of the generator through the next quarter of a turn, during which coil G^1 enters a field of opposite polarity and generates a current of opposite direction, and increasing strength, while coil G is passing from its maximum to its neutral position and generates a current of decreasing strength and same direction as before and causes a further shifting of the poles through the second quarter of the ring. The second half revolution will obviously be a repetition of the same action.

By shifting the poles of the ring A a powerful dynamic inductive effect is exerted upon the coils CC^1 .

Besides the currents generated in the secondary coil by dynamo-magnetic induction, other currents will be set up in the same coils in consequence of any variation in the intensity of the poles in the ring A . This should be avoided by maintaining the intensity of the poles constant, to accomplish which care should be taken in designing and proportioning the generator and in distributing the coils on the ring A and balancing their effect. When this is done the currents are produced by dynamo-magnetic induction only, the same result being obtained as though the poles were shifted by a commutator with an infinite number of segments.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed as communicated to me by my foreign correspondent I declare that what I claim is:—

1. The method of electrical conversion and distribution herein described which consists in continuously and progressively shifting the points or lines of maximum effect in an inductive field and inducing thereby currents in the coils or convolutions of a circuit located within the inductive influence of said field, as herein set forth.

2. The method of electrical conversion and distribution herein described which consists in generating in independent circuits producing an inductive field, alternating

Lak's Improvements relating to the Generation & Distribution of Electric Currents, &c.

currents in such order or manner as to produce by their conjoint effect a progressive shifting of the points of maximum effect of the field and inducing thereby currents in the coils or convolutions of a circuit located within the inductive influence of the field, as set forth.

3. The combination with a core closed upon itself, inducing or primary coils wound thereon and connected up in independent pairs or sets and induced or secondary coils wound upon or near the primary coil, of a generator of alternating currents and independent circuits connecting the primary coils with the corresponding coils of the generator, as herein set forth.

4. The combination with independent electric transmission circuits, of transformers consisting of annular or similar cores wound with primary and secondary coils the opposite primary coils of each transformer being connected to one of the transmission circuits, an alternating current generator with independent induced or armature coils connected with the transmission circuit whereby alternating currents may be directed through the primary coils of the transformers in the order and manner herein described.

Dated this 1st day of May 1888.

HASELTINE, LAKE & Co.,
45, Southampton Buildings, London, W.C.,
Agents for the Applicant.

LONDON : Printed for Her Majesty's Stationery Office,
By DARLING AND SON, LTD.

1888.

