(No Model.)

K. ZIPERNOWSKY, M. DÉRI & O. T. BLÁTHY.

INDUCTION COIL.

No. 352,105. Patented Nov. 2, 1886.

Fig. 1.

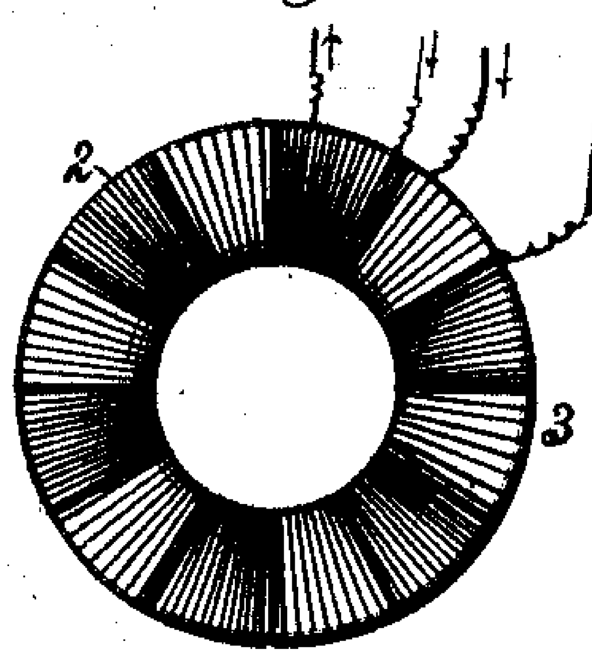


Fig. 2.

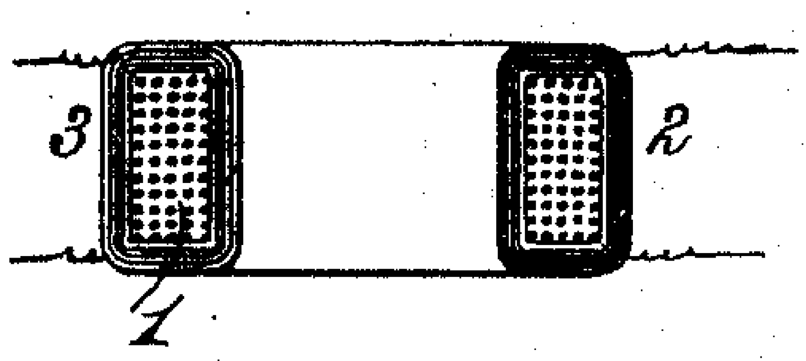


Fig. 5.

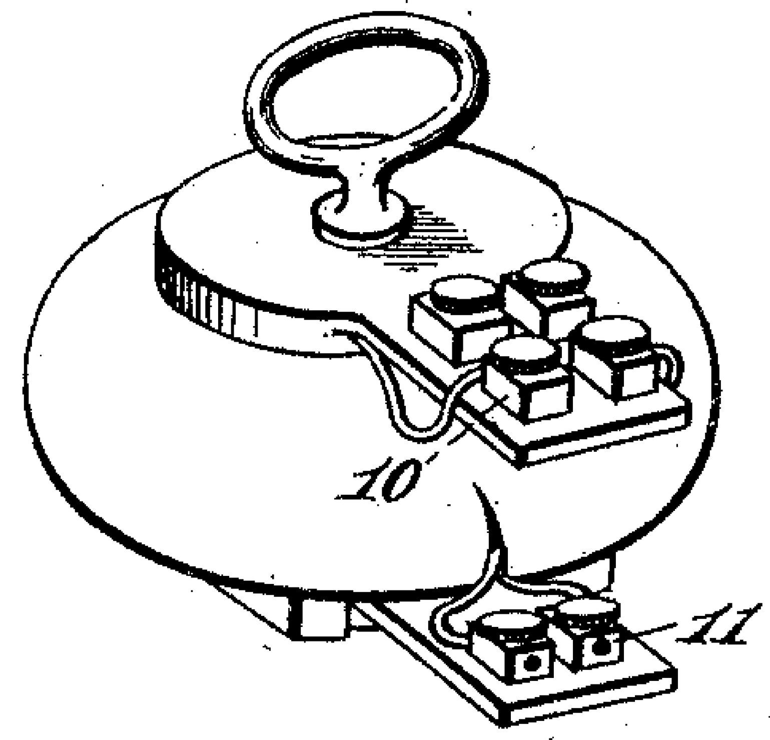


Fig. 3.

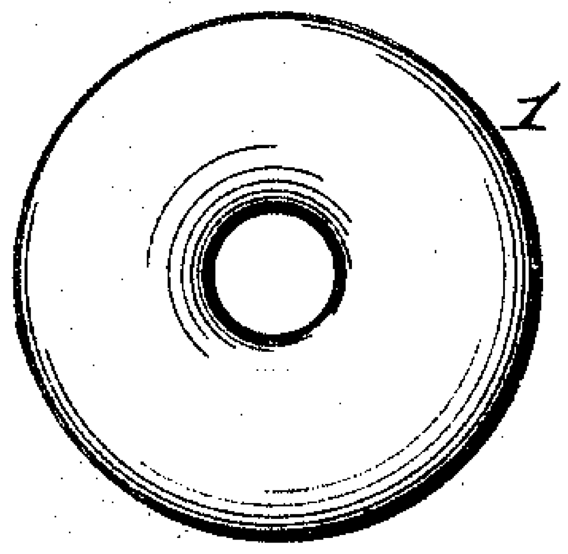


Fig. 4.

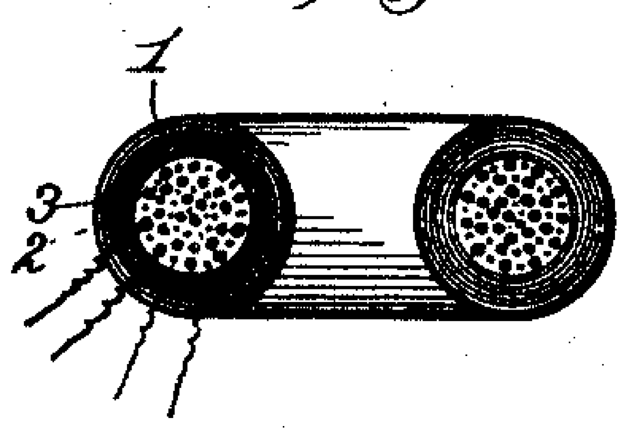


Fig. 6.

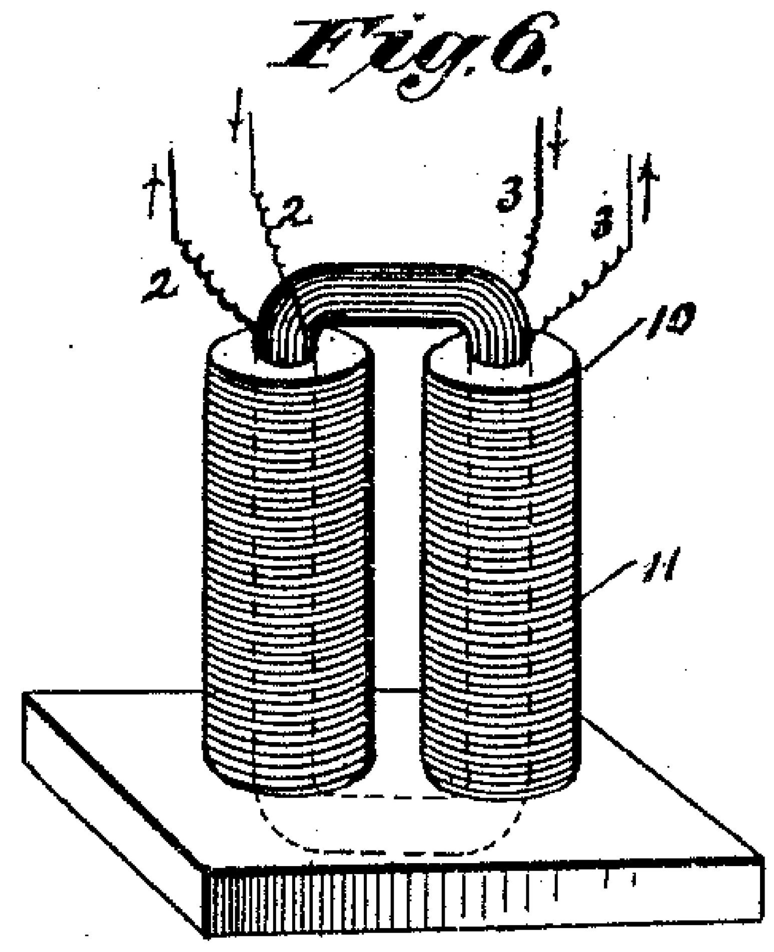


Fig. 7.

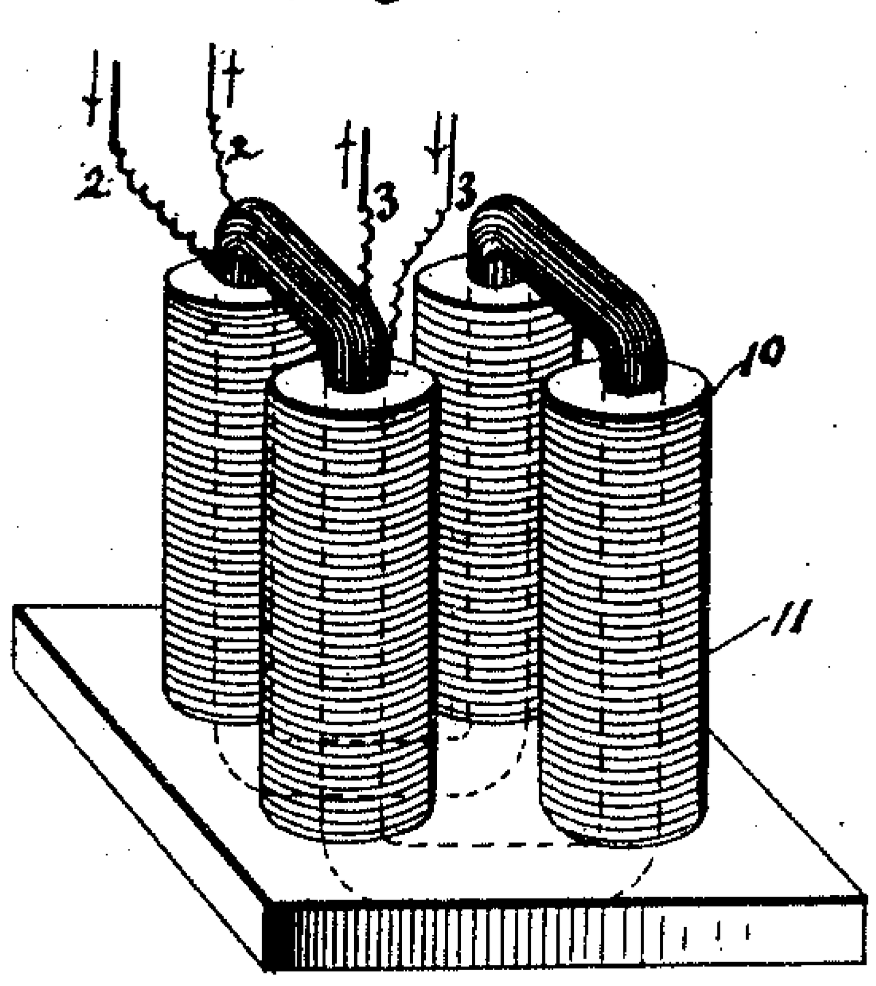
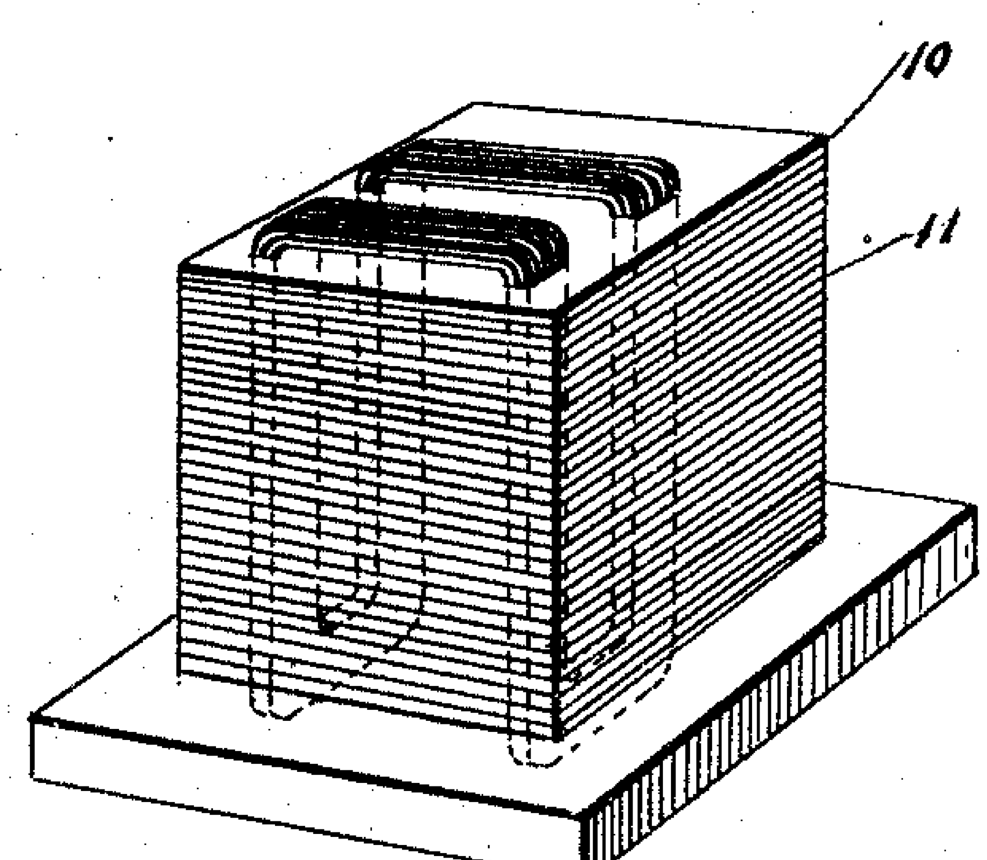


Fig. 8.



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UNITED STATES PATENT OFFICE.

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INDUCTION-COIL.

SPECIFICATION forming part of Letters Patent No. 352,105, dated November 2, 1886.

Application filed May 7, 1885. Serial No. 164,682. (No model.) Patented in Austria-Hungary March 3, 1885; in France April 21, 1885, No. 168,417; in Belgium April 21, 1885, No. 68,583; in England April 27, 1885, No. 5,201, and in Italy June 30, 1885, XXXVI, 154.

To all whom it may concern:

Be it known that we, KARL ZIPERNOWSKY, residing at Buda-Pesth, MAXIMILIAN DÉRI, residing at Vienna, and OTTO TITUS BLÁTHY, residing at Buda-Pesth, Austria-Hungary, subjects of the Emperor of Austria and King of Hungary, have invented new and useful Improvements in Induction Apparatus for Transforming Electric Currents, of which the following is a specification.

The object of the present invention is to solve the problem of distributing electrical energy in a practical and at the same time economical manner, and we attain this by inductional transformers for alternate currents with closed magnetic circuit.

Before entering into a description of our invention, we may premise that for the illumination of towns, as also generally in the case of the electric current requiring to be distributed over long distances, the so-called "secondary inductors" or "transformers" are specially adapted, as it is possible, by the aid of this apparatus, to distribute the current in a cheap and satisfactory manner over great, almost unlimited, distances. The conversion of currents of low tension into currents of high tension has been effected for years by means of Ruhmkorff's coil; but for general lighting purposes the use of currents of high tension is not desirable, and electricians have for a considerable time occupied themselves with the solution of the reverse problem. Another form of secondary generator recently brought into use has been found defective, for the reason that while a conversion of the currents take place the suppression of the iron core, that active agent in induction, is a decided retrograde step, since it has been found that the most appropriate means of considerably increasing the yield of secondary generators or transformers is to increase as much as possible the action of the iron in the apparatus, which is an incontestable fact, evidenced by the development of the dynamo-machine.

The inductional transformer devised by us differs in its outward form, as well as in its internal arrangement, from others heretofore known, and its advantages are greater yield and useful effect with the greatest possible simplicity and durability. These advantages we attain by increasing their inductive action as much as possible and removing all the possible causes of the loss of energy which operate during the conversion of electric currents; and since our transformer possesses the greatest yielding capacity it offers the greatest advantages with regard to the useful effect to be attained. Particularly is this due to the fact that our transformer is constructed in such a way as to prevent any dispersion of the lines of magnetic force, and as to place all the turns of the coils through which the currents flow, as it were, in a homogeneous magnetic field. This will cause the action of the induction to be the same on each particle of the copper wire, and the chief cause of the loss of energy—the Foucault currents—will be prevented.

The invention consists in an inductional transformer having an iron core, in which the lines of magnetic force can circulate without generating free magnetic poles, the core being made up of small sections insulated from one another parallel to the lines of force, in order to prevent the circulation of the objectionable Foucault currents, which would tend to flow in planes perpendicular to the lines of magnetic force were a core-piece of non-insulated sections employed. The primary and secondary coils are wound on the insulated iron core-piece in such a way, or are disposed thereon or relatively arranged thereto in such a manner, that every individual winding or turn of the secondary coil has the same electro-motive force, this being due to the fact that all windings inclose the same number of lines of magnetic force within the space or area covered by them on the core-piece. By connecting an alternating-current dynamo-electric machine with the primary coil the current from the former excites magnetism in the iron core, the direction of which magnetism alternates in rapid succession, and thus an alternating secondary induced current is excited in the secondary coil of the apparatus, this current passing off into a proper circuit and being utilized in any convenient way. It is to be observed that the iron in the transformer serves only as a medium for conveying the lines of force and not as a conductor for electric currents.

Figure 1 is a plan view of a transformer having a core formed of iron wire and surrounded by the primary and seconary coils of copper wire. Fig. 2 is a vertical section taken through Fig. 1. Figs. 3 and 4 show a reversed position of the copper and iron wires, the latter surrounding a core of insulated copper wire. Fig. 5 is a perspective view of a complete transformer made according to Figs. 3 and 4, and showing the connections and supports for the terminal and line wires. Figs. 6, 7, and 8 are different modifications of the transformer, in which the same fundamental principle obtains—that is to say, that the copper conductors are completely surrounded by iron, and that the latter is so arranged that the lines of force form circles in planes which are perpendicular to the copper conductors.

In the construction shown in Figs. 1 and 2 a ring or hoop shaped iron core (designated by the reference numeral 1) is composed of iron wires or circular sheets, varnished or otherwise insulated to prevent the circulation of the so-called "Foucault currents." Upon the iron core thus formed are wound insulated copper wires, constituting the primary and secondary coils, 2 and 3, of the apparatus. As shown in Fig. 1, the whole surface of the iron ring or hoop is covered with copper wires, the primary and secondary coils being disposed in alternate segmental sections. This mode of winding, however, is not essential, since the wires can be arranged in separate superposed layers, with the primary and secondary terminals connected, respectively, with the source of electric energy—viz., an alternating-current dynamo-machine—and the distributing circuit or the apparatus where the secondary currents are to be utilized, copper wires constituting the primary and secondary coils, 2 and 3, of the apparatus. The terminals of these coils (marked 2 and 3) are connected, respectively, with an alternating-current dynamo-machine, or other source of high-tension electricity, and the apparatus where the secondary or inducted currents are to be utilized.

In the construction shown in Figs. 3, 4, and 5, the iron and copper have changed places, the core in this instance consisting of insulated copper wires, which form primary and secondary coils, and are formed into a ring of a circular or other form in cross-section. The copper-wire core thus formed is provided with an insulating covering consisting of linen soaked in varnish, and is finally wound closely with thin iron wires, the windings of which are insulated from each other by a varnish-coating of the wires or by any other appropriate insulating medium.

In the construction shown in Figs. 3, 4, and 5 it will be seen that the primary and secondary coils are inclosed or surrounded by what may be termed an "exterior core," made of iron wire or strips properly insulated from each other parallel to the lines of force, and therefore, as in the construction seen in the other figures, the circulation of Foucault currents, and consequent heating of the apparatus, is prevented, and this source of the loss of the electrical energy in other induction devices is thus effectually removed. As seen in Fig. 5, the insulated iron wires form a complete covering for the primary and secondary coils, and the terminals of the latter pass through a gap in said covering or exterior iron core, and are connected with suitable binding-posts, 10 and 11.

It is apparent that in the above-described devices the directions of the lines of force in the iron not only suffer no interruption, but always form the shortest lines, and hence an active circulation will take place, first in one and then in the opposite sense, in accordance with the change of the direction of the inducing current in the copper wires. This is due to the fact that each particle of the copper conductor is surrounded by an equal number of iron wires, and consequently, also, by an equal number of lines of force—that is to say, if the distribution is to be regarded with respect to space and not to cross-section. The extremely powerful action of such transformers is apparent; also, that they present a perfect system of equilibrium for the electrical and magnetic reversing action, and that the transformation is effected with great simplicity and regularity by the induction brought into action by comparatively small masses.

In place of insulated iron wires constituting a core, as in Fig. 1, or such wires being wound around copper wires, as in Figs. 3 and 4, we may use iron plates 10, which are superposed upon each other like the elements of a dry voltaic pile, sheets 11 of insulating material being placed between the iron plates. Into a hole formed in the middle of the column of plates thus formed, are introduced the insulated copper wires which are conducted through both columns and have their terminals suitably arranged for the reception and distribution of electrical energy.

In Fig. 6 two columns, formed of iron plates, are shown, whereas in Fig. 7 four such columns are represented. It should be observed that the number of columns may be increased; but in all instances the direction of the flow of current through two contiguous or touching columns is in an opposite direction. It is also to be observed that instead of making the columns shown in Figs. 6 and 7 of iron plates, the copper core when of an oblong shape has only the straight parts of it inclosed by insulated iron wires, these wires being wound spirally or otherwise on the copper core.

In the construction shown in Fig. 8, iron plates 10, of any preferred shape, are employed, these plates being provided with holes in several places, so that when the parts are piled upon each other these holes will register and form continuous passages throughout the entire height of the column of plates. Strips 11 of insulating material are interposed between each pair of plates, and through the holes formed therein the copper wires are conducted back and forth in such a way that the current in two parallel neighboring branches of the wire must flow in opposite directions. The inductive effect of such a column of plates is the same upon each branch of the wires, and for this reason the united effects give a very high result. It is to be stated that instead of placing insulating-sheets between the plates constituting the columns, we may cover the plates themselves with an insulating material—such as varnish, &c.

While we have shown several preferred constructions as the most efficient embodiment of our invention we wish it to be understood that other modifications will readily suggest themselves. For example, the number of plates in the columnar form of apparatus may be varied and likewise the manner of winding the various wires may be changed. Furthermore, instead of using copper wires for conducting the currents, we can make use of bars or tubes for a like purpose.

We are aware that Faraday in his experimental researches made use of a welded ring of soft round iron of small diameter and partly wrapped the same with wire constituting the primary and secondary coils of an induction apparatus. In such arrangement there exists an iron core closed upon itself for causing the lines of magnetic force to circulate entirely within it; but it cannot constitute an efficient inductorium and is not adapted for the purposes for which our transformer is designed, since the massive or homogeneous iron ring allows the so-called "Foucault currents" to freely circulate, and the latter are made to consume the greater part of the energy furnished by the electric current, and will in a very brief space of time cause the destruction of the apparatus by their heating action upon the same.

What we claim as our invention is—

1. An inductional transformer consisting of primary and secondary conductors wound or extending continuously in the same direction and having free terminals and an iron core or body closed upon itself and around said conductors, the core or body being formed of sections insulated from each other parallel to the lines of magnetic force, substantially as herein set forth.

2. An inductional transformer consisting of a closed hoop or ring-shaped iron core made of sections insulated from each other parallel to the lines of force and primary and secondary helices wound uniformly and continuously in the same direction on the core and having free terminals, substantially as herein set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

KARL ZIPERNOWSKY.
MAXIMILIAN DÉRI.
OTTO TITUS BLÁTHY.

Witnesses:
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HENRY STERNE.