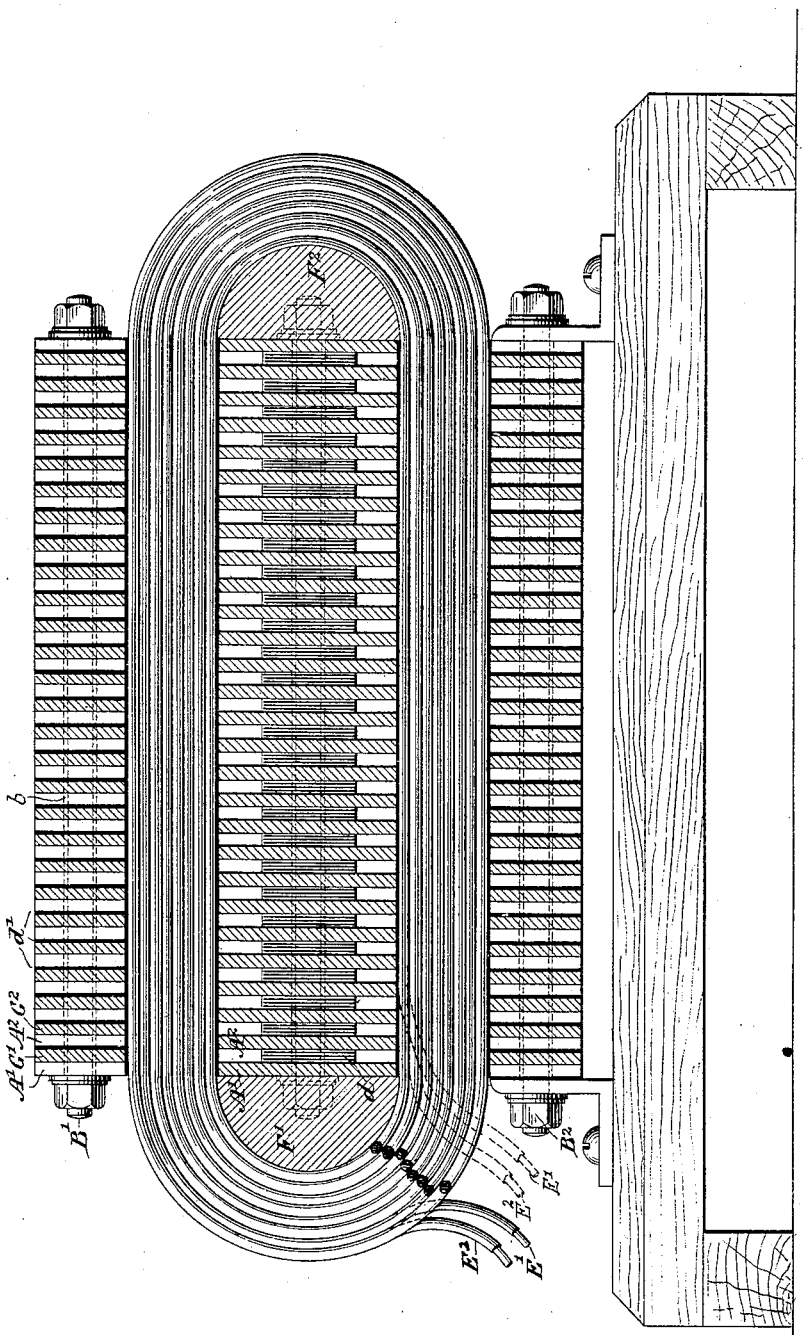
(No Model.) 3 Sheets—Sheet 1.

G. WESTINGHOUSE, Jr.

INDUCTION COIL.

No. 342,553. Patented May 25, 1886.

Fig. 1.



Witnesses

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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2,

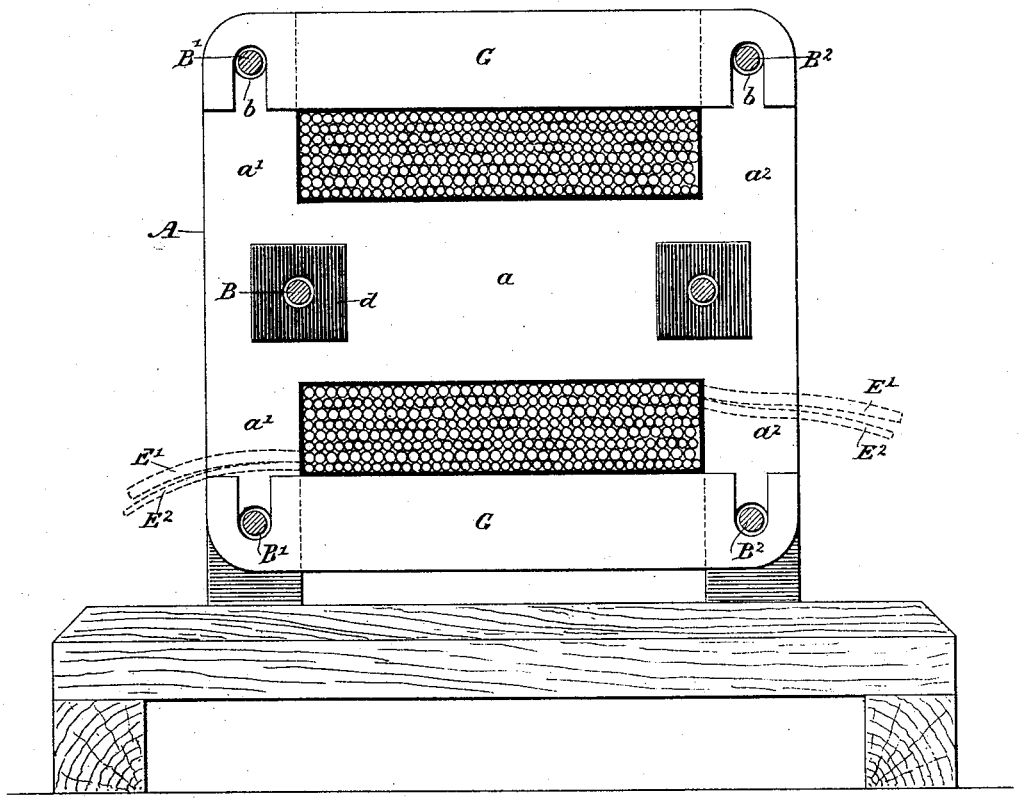

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Fig. 4.

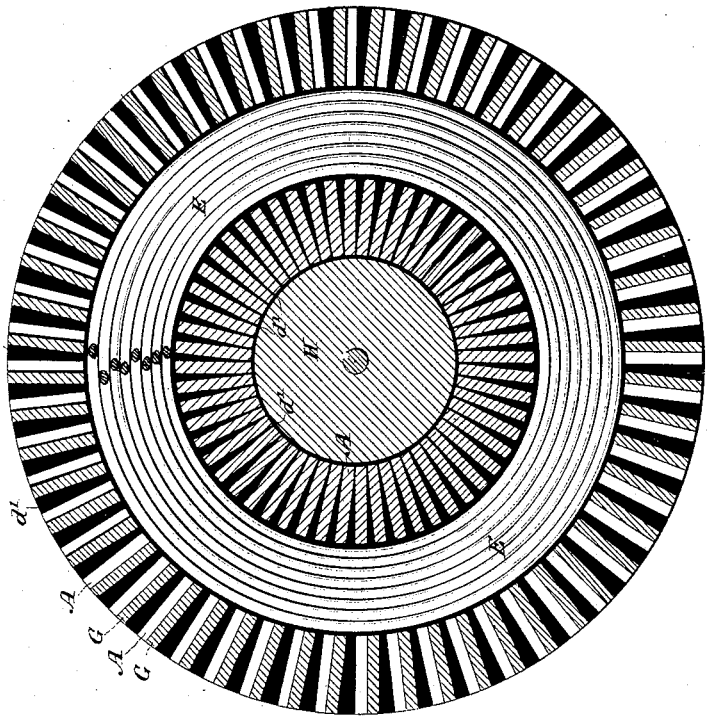
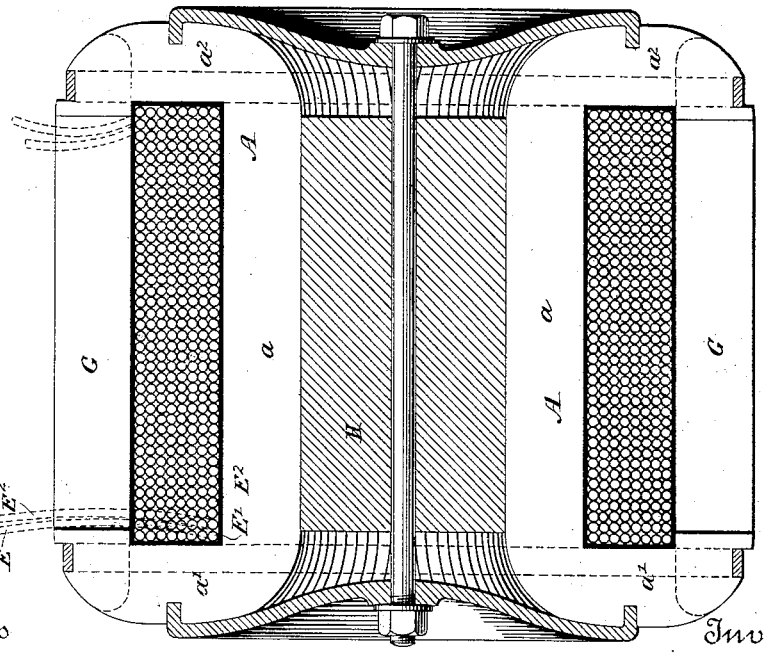


Fig. 3.



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UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

INDUCTION-COIL.

SPECIFICATION forming part of Letters Patent No. 342,553, dated May 25, 1886.

Application filed February 16, 1886. Serial No. 192,071. (No model.)

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., a citizen of the United States, residing in Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Induction-Coils, of which the following is a specification.

My invention relates to the class of electrical apparatus commonly employed for transforming electric energy of another form.

It has long been customary to employ induction-coils or converters for transforming electric currents of considerable quantity and low potential into currents of high potential and small quantity, but the conversion of high potential currents into currents of low potential without modifying the quantity is equally practicable, and also the conversion of currents of a given quantity into currents of greater quantity. Whatever be the particular form of conversion required, it is desirable that the entire current in the primary circuit be utilized in developing magnetism in surrounding iron, and that this magnetism shall in turn be expended upon the secondary coils and develop the greatest possible amount of current therein. To bring as large an amount of iron into as close proximity as possible to the primary and secondary coils, and yet construct the converter in such manner that there shall be but little loss of energy through heating the iron, and to render it capable of rapid charge and discharge is the object of the present invention.

The invention consists in constructing a converter in substantially the following manner: A number of thin soft-iron plates, each consisting of two parallel end pieces connected together by a central web, are bolted together side by side. The plates are separated from each other by intervening washers or plates of non-magnetic material—such as vulcanized fiber—and an air-space may be left, if desirable, between each two plates. The bolts are surrounded by tubes of vulcanized fiber or other non-magnetic material, or they may themselves be of non-magnetic material, such as brass. Preferably, however, vulcanized fiber is employed for separating the plates from each other and from the bolts, or some equivalent material which will serve to separate them electrically as well as magnetically.

Where large continuous masses of iron are rapidly magnetized and demagnetized they become heated, and there is a consequent loss of electrical energy. The thinner the plates are made the less will be the energy expended in heating them. For this reason the plates of which the core is composed are themselves made quite thin, and this construction also permits the coil to charge and discharge quickly. In the open space formed by the end pieces and the webs of the series of plates the primary and secondary conductors are wound, preferably, in alternate layers. After the spaces have been filled by the convolutions of these conductors outside plates of soft-iron are placed between the arms of the outside arms or end pieces, and these serve to inclose or completely surround the conductors by laminæ of iron. The outside plates are respectively in magnetic contact with corresponding foundation-plates, but insulated from all the others. Each foundation-plate, therefore, in conjunction with the outside plate, forms a complete ring about the primary and secondary conductors. The plates may be arranged in a straight series, being placed side by side and in parallel planes, or they may be formed in a cylindrical series radiating from a common center. In the latter case each plate would have arms extending from one side only.

In the accompanying drawings, Figure 1 is a cross-section of an induction-coil or converter embodying the features of the invention; and Fig. 2 is an elevation of the same, partly in section. Fig. 3 is a longitudinal section, and Fig. 4 is a cross-section, of a modified form.

I am aware that the primary and secondary conductors of a converter have been surrounded by masses of soft-iron composed of magnetically-separated soft-iron disks, through which the conductors are led.

Referring to Fig. 1, $A' A^2$, &c., represent thin plates of soft iron, which may be conveniently formed by stamping. Each plate consists of a central web, *a*, having T-shaped ends. The arms $a' a'$ and $a^2 a^2$ of the latter project in opposite directions from the web, and form therewith two rectangular spaces, designed to re-

ceive the wire of the primary and secondary coils. The plates are bound together, side by side, by longitudinal bolts B′ B′ and B² B²; but they are separated slightly from each other by washers *d′ d′*, surrounding the bolts. The bolts themselves are preferably surrounded by tubes *b*, of vulcanized fiber, and the washers are preferably of the same material. Instead of having the washers surround the bolts merely, they may be extended to cover the entire surfaces of the plates A′ A², &c. The primary and secondary conductors E′ and E², respectively, are wound longitudinally upon the laminated core thus formed, and they fill the rectangular spaces. They may with advantage be wound in alternate layers, though this may not always be a necessary construction. Against the ends of the series of plates are placed rounded blocks F′ and F², of wood or other suitable material, for the purpose of affording curved ends, over which the conductors are wound.

The primary and secondary conductors may with advantage be of equal size and more or less of the convolutions of one coil included in multiple arc with each other, as required, to obtain currents of the required character. The sizes may be varied, however, as found expedient.

After the conductors have been wound in place, short plates G′ G², &c., of iron, are placed across the ends of the projecting arms *a′ a²*, and these serve to magnetically connect corresponding arms with each other upon each side of the coils, forming complete rings of magnetic material about the coils. The wire is thus completely inclosed by a series of rings of magnetic material. The plates G′ G², &c., are insulated from each other magnetically, and preferably also electrically, by washers or plates *d d*, of vulcanized fiber or other suitable material.

In Figs. 3 and 4 a modified form is shown. In this instance, the plates A A, &c., are formed with a curved arm at each end of the web *a*, as shown at *a′* and *a²*. The plates radiate from a common center, and may be conveniently supported upon a block or cylinder, H, which is preferably of wood or other non-magnetic material. The plates are magnetically, and preferably also electrically, separated from each other, in essentially the same manner as described with reference to Figs. 1 and 2, by means of plates *d′ d′*. The primary and secondary conductors E′ and E² are wound about the core formed by the webs *a*, filling the space between the arms *a′ a′* and *a² a²*, and then plates G′ G², &c., are placed outside the coils connecting the respective arms *a′* and *a²*.

I claim as my invention—

1. An inductorium or converter consisting of two coils of wire, a core around which successive convolutions of the same are wound, consisting of laminæ of magnetic material extending in a direction at right angles to the direction of the wire of the coils, and a mechanically separate outer laminated shell of magnetic material, the outer laminæ respectively being magnetically connected with the laminæ of the core.

2. An inductorium or converter consisting of a series of thin plates having outwardly-projecting arms, plates connecting the ends of said arms, and conductors within the spaces between said arms.

3. The combination, substantially as hereinbefore set forth, of a series of double-T-shaped plates of soft iron arranged side by side and magnetically separated, primary and secondary coils wound upon the same longitudinally, and plates of soft iron connecting the outer ends of the arms of the T-shaped plates, substantially as described.

4. The combination, substantially as hereinbefore set forth, of a series of plates of soft iron having two pairs of oppositely-projecting arms, coils of insulated wire wound in the spaces between the arms, and plates connecting the outer ends of the arms, substantially as described.

In testimony whereof I have hereunto subscribed my name this 11th day of February, A. D. 1886.

GEO. WESTINGHOUSE, JR.

Witnesses:
R. H. WHITTLESEY,
C. M. CLARKE.