(No Model.)

J. J. BELLMAN & C. T. RITTENHOUSE.

ELECTRIC TRANSFORMER.

No. 605,194. Patented June 7, 1898.

Fig. 1.

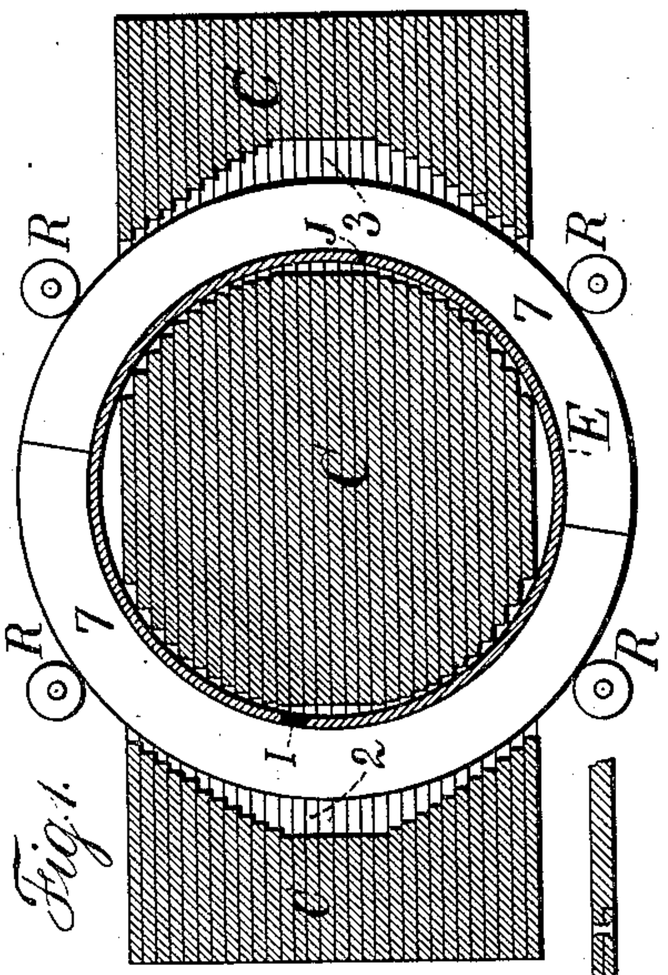


Fig. 2.

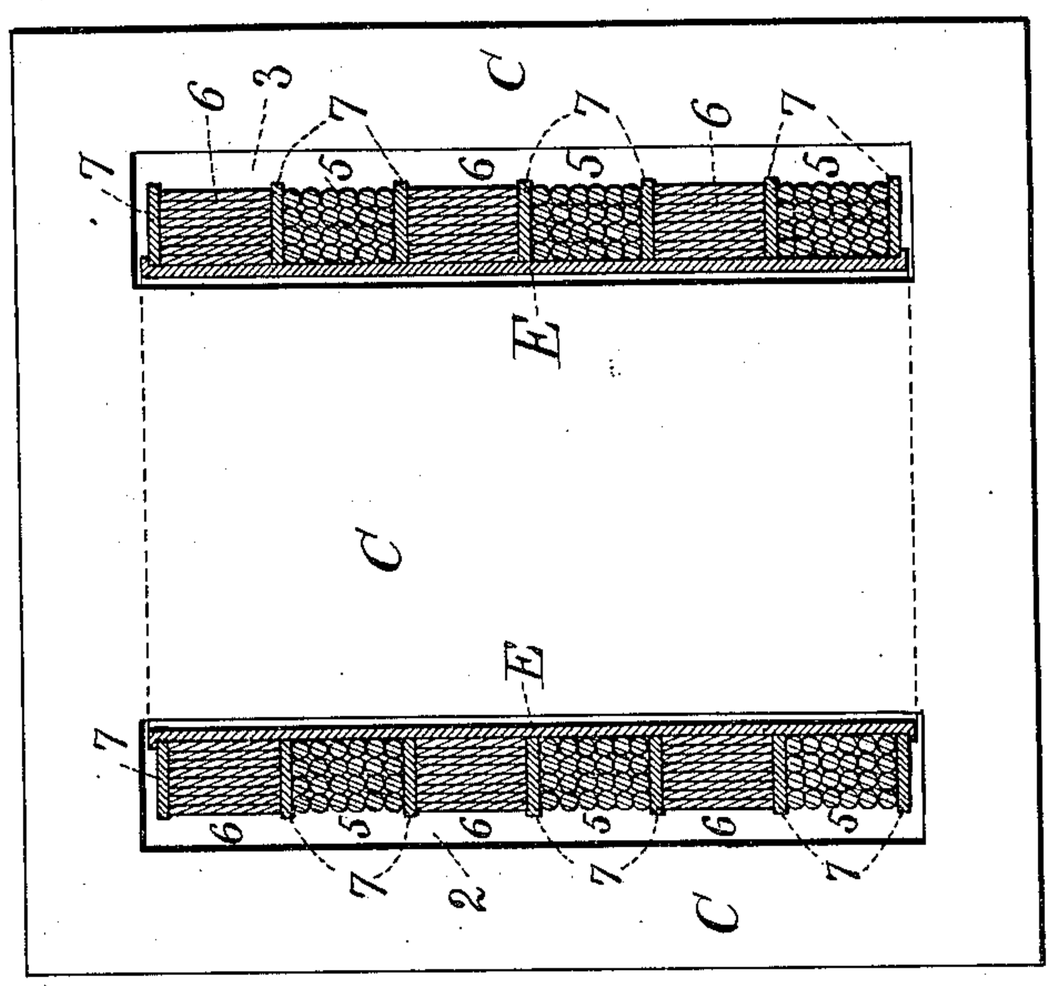


Fig. 3.

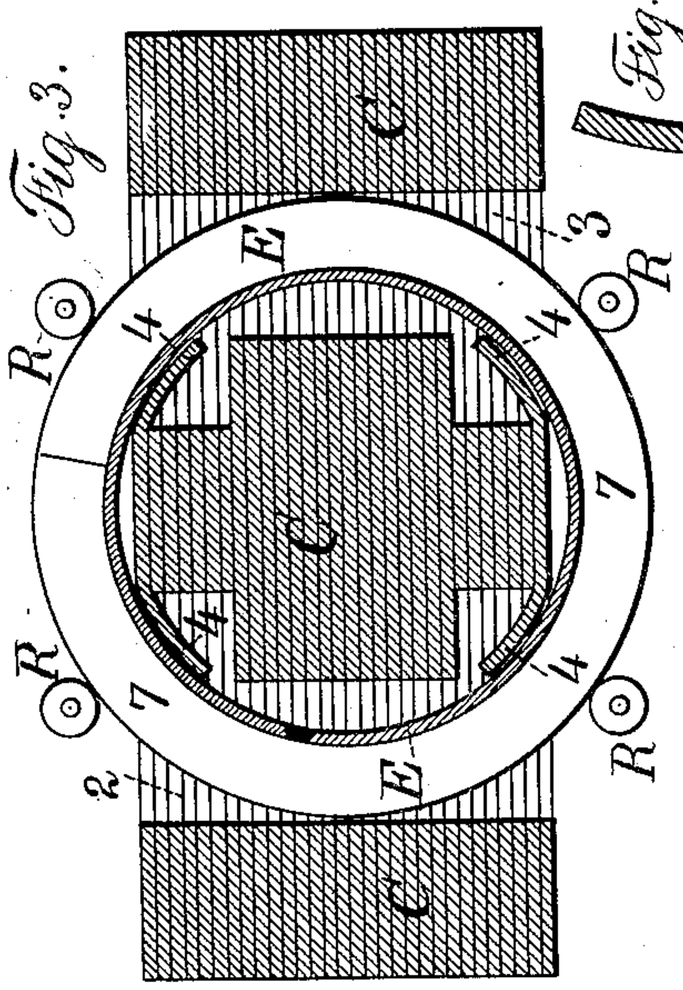


Fig. 4.

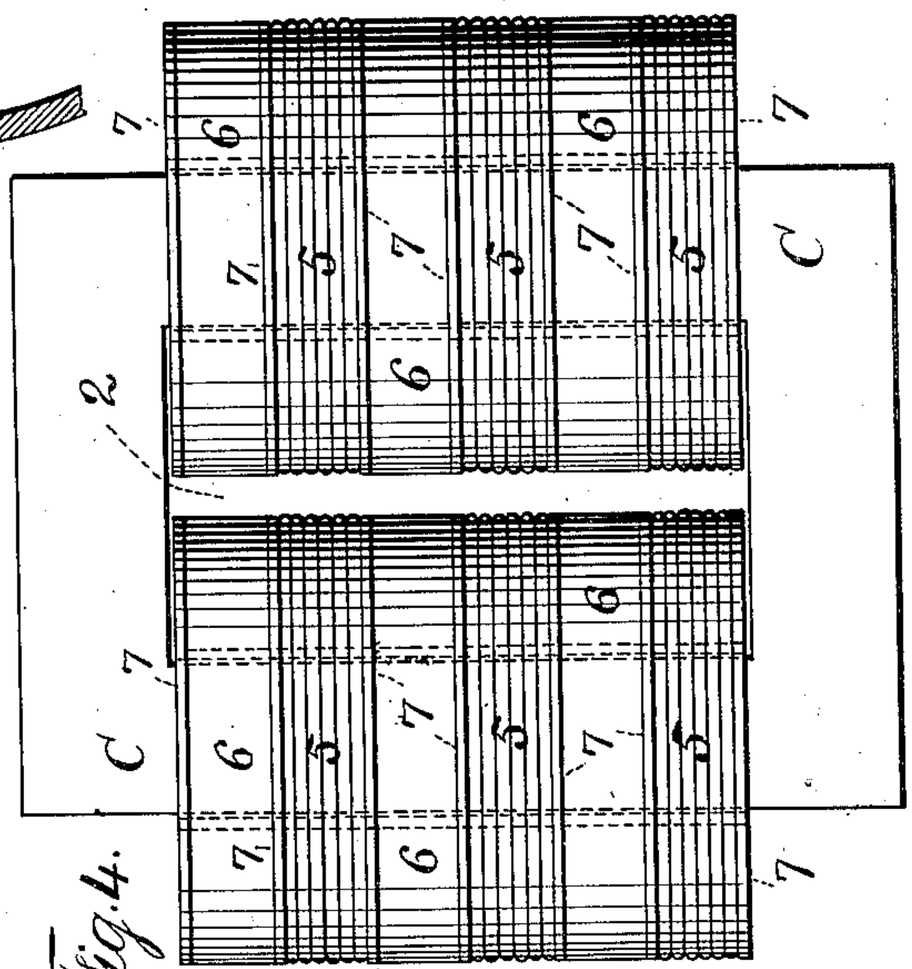
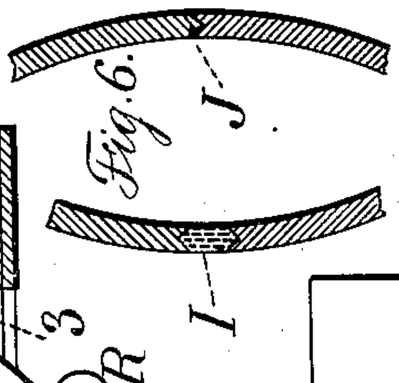


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN J. BELLMAN AND CHARLES T. RITTENHOUSE, OF NEW YORK, N. Y.

ELECTRIC TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 605,194, dated June 7, 1898.

Application filed June 29, 1897. Serial No. 642,879. (No model.)

To all whom it may concern:

Be it known that we, JOHN J. BELLMAN and CHARLES T. RITTENHOUSE, citizens of the United States, residing in the city, county, and State of New York, have invented an Improvement in Electric Transformers, of which the following is a specification.

Electric transformers have sometimes been made with circular cores of rectangular cross-section built up of iron plates around which the primary and secondary wires have been wound by hand. In others the core has consisted of a coil of iron wire around which the primary and secondary wires were wound. The primary and secondary conductors have also been wound in a coil and surrounded by iron wire wound by hand, or plates of magnetic material sectionally divided have been built up about said primary and secondary coils.

It is well known that an air-gap, lap, or butt-joint in a ferromagnetic circuit offers considerable resistance to the magnetic flux, and in overcoming the same additional energy is required. At least one such joint or air-gap is present in all types of electric transformers in which the magnetic circuit is composed of magnetic material not entire and continuous along the path of the magnetic flux.

In our present improvements in electric transformers the magnetic field is composed of plates or layers of magnetic material without joints, laps, butts, or air-gaps, each plate being integral.

In the drawings, Figure 1 is a cross-section of our improved transformer. Fig. 2 is a longitudinal section. Figs. 3 and 4 show modifications in the shape of the magnetic field. Fig. 5 shows the preferable manner of connecting the ends of the rings or heads or of the cylinder, and Fig. 6 shows details in larger size of the manner of making the cylinder of segments and insulating the same.

The field C is composed of magnetic material in the form of plates or sheets, the core being integral with the other parts, and the sheets have mortises at 2 and 3 of the proper size and shape for the admission of the primary and secondary coils, so that the magnetic flux is free to circulate through the entire field without the resistance due to lapping plates that are not integral or to the presence of air-gaps.

The term "field" in this specification is to be considered as including the circuit or circuits made up of magnetic material and the term "core" is applied to that part of such circuit or circuits surrounded by the electric conductor.

The mortises should be cut with reference to the position of each plate in the pile of plates, in order that when the plates are put together in the pile the core or that part of the field about which the coils are wound may be substantially of circular cross-section. This, however, is not indispensable, because the plates may be cut out approximately as shown either in Fig. 3 or Fig. 4, so that when properly assembled they will form one or more cores around which the coils are placed. These openings may be of any desired form. It is sometimes advantageous to cut the outer field-plates for the opposite sides of the pile sufficiently wide to provide for bending such plates, as shown at 4, to form the guides for the spool.

A sectional or divided spool is made use of, consisting of a cylinder E, which may be of paper or other material, with two or more rings or heads 7. The spool may be made in one or more pieces, so that it may be placed in position around the core. The parts of the cylinder may be joined together and secured or held in position in any desired manner.

If the spool is made of sheet metal, it is advisable to so construct it as to prevent the circulation of eddy-currents. This may be accomplished by the interposition of an insulating-strip, as shown at I, Fig. 6. The heads or rings 7 can be made in sections and joined in any desired manner, such as shown at L, Fig. 5, or they may be split open at one place and introduced around the cylinder and then united at the opening, if desired, by laps and rivets, or secured to the cylinder E in any suitable manner, the special object being to provide a spool sufficiently strong for winding the coils upon it and at the same time sufficiently free to be revolved around the core. This spool is to be rotated for the purpose of building up the electric conductor in convolutions around the core, and hence the coils can be wound upon this spool by turn-

ing the spool by hand or by any suitable mechanism adapted thereto. The spool or cylinder may be supported upon wheels or rollers, as shown at R, Figs. 1 and 3, which act as guides, and it may then be rotated in the manner above stated, or it may be rotated by the guide rollers or wheels themselves, which can be revolved by any suitable power.

In winding the primary and secondary coils 5 and 6 the coils may be combined or grouped in any desired manner. We, however, prefer to wind the primary and secondary wires in separate coils, as shown in Figs. 2 and 4. These coils when side by side around the core are advantageously separated by rings 7, which may also form the heads of the spools, so that if any defect arises in any coil the coil may be easily unwound or removed and another substituted.

It is of course understood that the primary coils and secondary coils may be connected electrically in any desired manner in their respective circuits. It may be advantageous to use strips or bands for either primary or secondary conductors, or for both, as illustrated in the section Fig. 2 at 6. It is also advantageous to fill the mortised space of the field as completely as possible with the coils.

By the present improvements it is possible to economically construct transformers having distinct advantages over those hitherto made because the field has a minimum magnetic resistance and therefore requires a minimum magnetizing-current. The coils which surround the core or cores are wound with rapidity, so as to avoid consuming unnecessary time threading the wires through the mortised fields. This construction also affords a ready means of dividing up the coils or helices upon the core in such a manner that the primary and secondary coils are easy of access, and in case of defect or injury any coil may be removed and another substituted without disturbing the remaining coils. The magnetic leakage and resistance are reduced to a minimum.

We claim as our invention—

1. The combination in a transformer, of a ferromagnetic field built up of integral plates so mortised that when the plates are properly assembled the core of the magnetic field will be approximately circular in cross-section, substantially as set forth.

2. The combination in a transformer, of a ferromagnetic field, composed of mortised plates, a divided spool or spools interlinking with the magnetic field, and means for causing the spool or spools to revolve, substantially as set forth.

3. The combination in a transformer, of a ferromagnetic field, a spool or spools interlinking with such field and rollers for supporting the said spool or spools and for causing them to revolve about the core or cores of the magnetic field, substantially as set forth.

4. The combination in a transformer, of a ferromagnetic field of integral plates each having a mortise through it and a sectional or divided spool or spools interlinking with the ferromagnetic field and primary and secondary wires wound upon said spool or spools by rotating said spool or spools around the core or cores of said ferromagnetic field, substantially as set forth.

5. The combination in a transformer, of a ferromagnetic field built up of plates, and a sectional or divided spool or spools interlinking with the ferromagnetic field and the winding of wire around the core or cores of said ferromagnetic field by the turning of said spool or spools on the core or cores, substantially as set forth.

6. The combination in a transformer of a ferromagnetic field built up of plates, a sectional or divided spool or spools interlinking with the core and rollers for supporting the spool while being rotated, substantially as set forth.

Signed by us this 23d day of June, 1897.

JOHN J. BELLMAN.
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