(No Model.)

E. THOMSON.

ELECTRICAL TRANSFORMER.

No. 516,850. Patented Mar. 20, 1894.

FIG. 1.

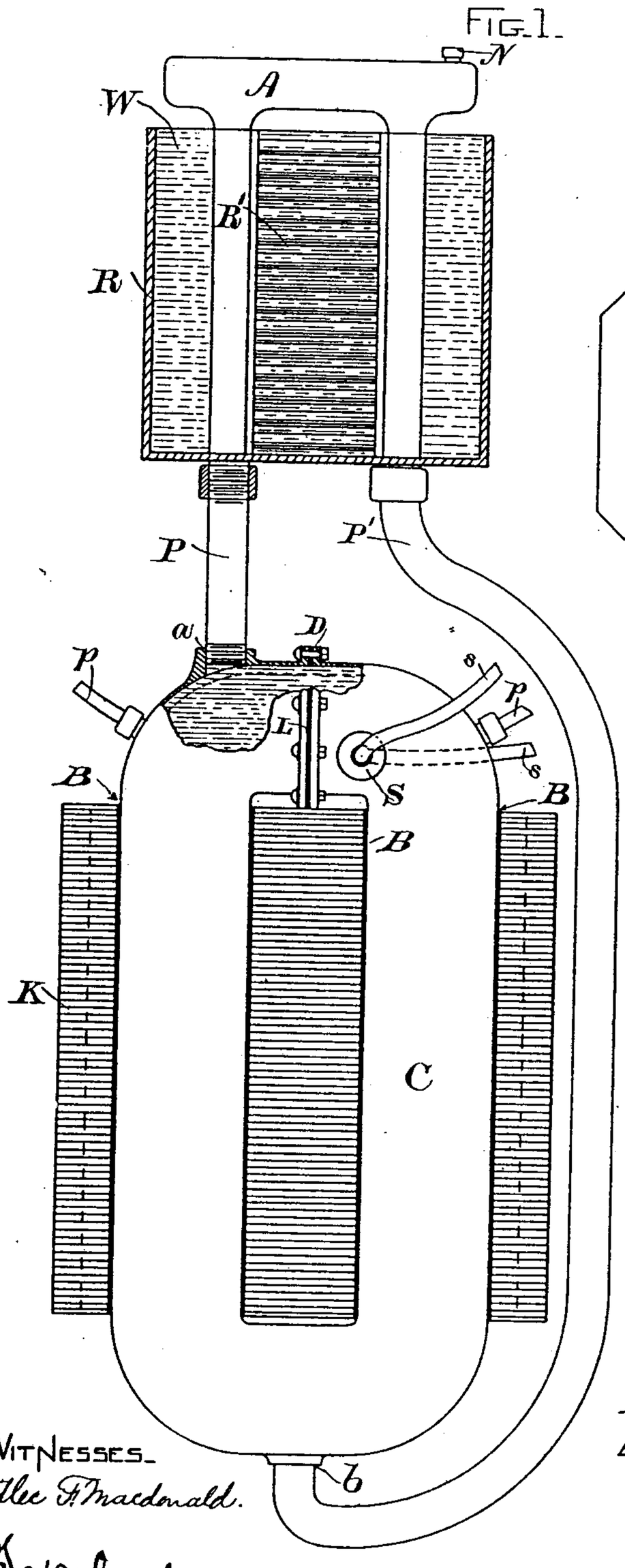


FIG. 2.

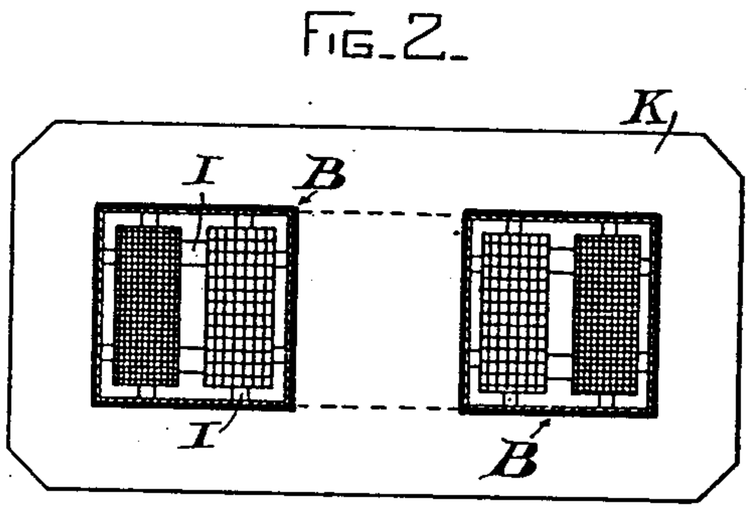
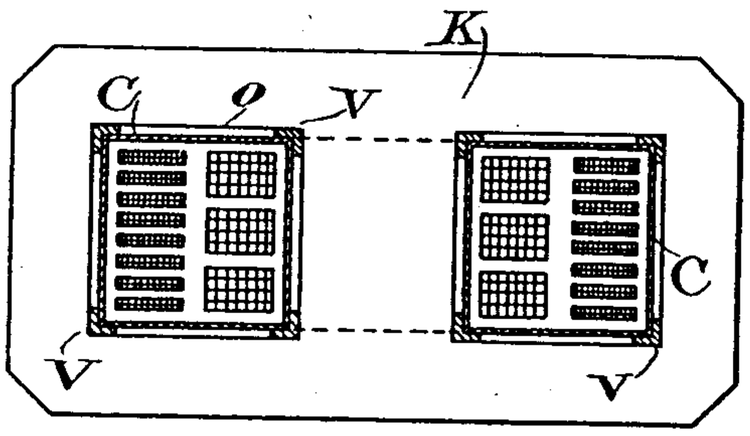


FIG. 3.



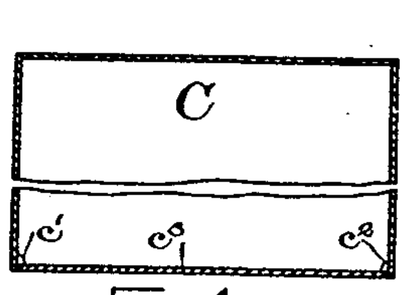


FIG. 4.

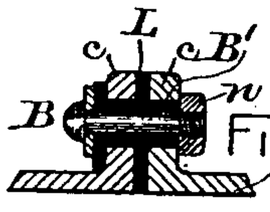


FIG. 6.

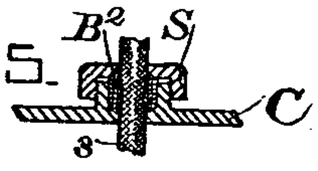


FIG. 5.

WITNESSES.

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ELECTRICAL TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 516,850, dated March 20, 1894.

Application filed June 28, 1893. Serial No. 479,096. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, in the county of Essex and State of Massachusetts, have invented a certain useful Improvement in Transformers, of which the following is a specification.

My invention relates to transformers for use on high potential circuits; and has for its object to provide a ready and efficient means of cooling the coils, primary and secondary, of such transformers, thus preventing the rise of temperature to such an amount as may reduce the potential of the delivered current under load, or may cause injury to the insulation of the transformer. To this end I inclose the coils in a case of metal or insulating material situated between the coils and the core, which case I prefer to make with tight joints and to nearly fill with an insulating fluid, such as oil, as in my Patent No. 493,313, dated March 14, 1893, providing also suitable cooling means, as more fully pointed out hereinafter.

In the accompanying drawings hereunto annexed and hereby made part of this specification, Figure 1 is a side elevation partly in section of my improved transformer. Figs. 2 and 3 are sectional views of modifications thereof. Fig. 4 is a cross section of the inclosing casing. Fig. 5 is a cross section of the gland through which the leading-in wires are passed, and Fig. 6 shows the insulating joint of the inclosing casing.

In Fig. 1, C is the inclosing casing, which is provided with an insulating joint D, and is made either of insulating material or of some metal, such as copper, for reasons hereinafter pointed out. To prevent the casing C becoming a short-circuited secondary to the transformer (when made of metal), it is necessary that it should be discontinuous; this is provided for by the insulating joint D, more fully illustrated in Fig. 6; where L is a sheet of mica, hard rubber or other proper insulating material, passed between the ends of the casing, which are provided with lugs *c*, *c*; through the lugs is passed a bolt B around which is a sheath B′ of insulating material, serving to prevent the bolt from making connection between the two sides of the inclosing casing. The bolt is secured by the nut *n*.

The casing may be made of thin iron or of diamagnetic metal, as copper, because I have discovered that such a casing serves to some extent to prevent leakage of magnetic lines of force.

In the casing suitable openings are made for the entrance and exit of the primary and secondary wires of the transformer. These openings are protected by a gland illustrated in Fig. 5; wherein B^2 is a packing of soft rubber or other compressible insulating material through which the wire *s* is led to the interior of the casing. The cap S of the gland is then screwed down, compressing the packing B^2 tightly around the wire, and making a water-tight or oil-tight joint.

I prefer to provide auxiliary means for cooling the surrounding fluid in the casing C. To this end I provide in the casing an aperture *b* at the bottom and another aperture *a* at the top; from the two openings pipes P, P′ are led to the auxiliary cooling vessel R, which I prefer to locate above the transformer, in order that the currents set up by convection in the liquid contained in the casing may cause it to ascend to the parts of the pipe contained in the cooling vessel R.

R′ is a radiator in the vessel R which is completely surrounded by water, W; I may also provide means for changing the water by any suitable system of circulation should it be found desirable; or it may be found sufficient to locate the radiator R′ in a chimney or other place where a draft of air may pass over it to convey away the heat.

K is the laminated core of the transformer; *s*, *s* are the secondary wires and *p*, *p* are the primary wires.

As illustrated in Figs. 2 and 3, it is desirable that the primary and secondary cores should be separated from each other by a small space; and this separation is effected by the insulating blocks I, I, as shown in Fig. 2. To increase the circulation of the liquid, the coils in the large transformer may be divided into sections with spaces between them,

thus not only affording greater surface for conveying away the heat but also lessening the danger of short circuits where currents of high potential are employed.

The construction of inclosing case illustrated in Fig. 4 affords a ready means of inclosing the coils in the casing. In this figure c', c^2 are lugs on the side of the casing C, which prevent the lid of the casing c^3 from dropping down; while sustained in this way it is carefully soldered in place. The whole apparatus being put together as thus described, oil is poured into the space A provided at the top of the pipe P, P', through the aperture sealed by the plug N; the plug is then screwed in tightly and the apparatus is ready for use, its operation being readily understood from the foregoing description. The space A is provided for the expansion of the liquid insulating material by the heat, or it may be left open at the top. By the construction described I am enabled to build a transformer in which no arrangement need be used to cool the iron core K, it being allowed to run as hot as may be under the condition of service. It might, however, be provided with openings for ventilation if desired, but when such spaces are omitted it enables me to reduce the length of the primary and secondary coils and thus the C^2 R loss (that is the loss due to the coil resistance), is reduced. Instead of using the radiator R' for cooling the heat of liquid as described herein, the whole apparatus might if desired be wholly or partly submerged in water, or a stream of water may be directed upon it, care being taken to see that the primary and secondary leading-in wires are properly insulated.

In order that the division of the casing at D may be effective in preventing short circuits when such casing is made of metal it is of course desirable that the iron laminæ be kept out of contact with it, at least on one side and especially near the top or near the break at D. To this end and also to prevent escape of heat from the iron to the casing, which may be desirable, I prefer to coat or wrap the casing in a layer of paper or other insulator, as indicated at B, B, &c., in heavy black lines, though it would be sufficient to have the casing somewhat smaller than the space in the iron laminations so as to leave a full space, as at O, Fig. 3, around the casing, suitable supporting means being provided to hold the casing in place, such as wedges of wood, or other material.

Having thus described my invention, what I claim as new, and wish to protect by Letters Patent of the United States, is—

1. A transformer comprising primary and secondary coils, a common iron core therefor and a casing containing the coils and located between the coils and the core.

2. In a transformer having a closed magnetic circuit of laminated or divided iron, a casing surrounding both primary and secondary coils located between the coils and the core, and suitably insulated, as described, so as not to form a closed circuit parallel to the winding of either the primary or secondary coil.

3. In a transformer, primary and secondary coils inclosed within a casing surrounding said coils but not inclosing the iron core, and containing an insulating fluid, in combination with means for cooling such insulating fluid.

4. In a transformer, a casing, as C, interposed between the core and the coils and filled with insulating fluid, such casing being provided with an insulated joint, as shown, and openings for the leading-in wires.

5. In a transformer, a casing, as C, interposed between the core and the coils, suitably insulated therefrom, and filled with insulating fluid, such casing being provided with an insulating joint and openings for the leading-in wires, in combination with means, consisting of circulating pipes and an inclosing vessel, adapted to convey away the heat from the insulating fluid in the casing.

6. The combination in a transformer, of primary and secondary coils surrounding the same magnetic core, a casing inclosing said coils only and having an insulating space between it and the iron core, and an insulating and cooling fluid contained within said casing.

7. In a transformer, primary and secondary coils divided into sections, in combination with a sealed casing of metal interposed between such coils and the core of the transformer, but insulated from the latter, such casing being provided with openings for the leading-in wires.

8. In a transformer, primary and secondary coils divided into sections and a closed casing of metal interposed between such coils and the core of the transformer, such casing being provided with openings for the leading-in wires adapted to be packed after their insertion, in combination with means, consisting of suitable circulating pipes and a cooling vessel, adapted to convey away the heat from the insulating fluid.

In witness whereof I have hereunto set my hand this 15th day of June, 1893.

ELIHU THOMSON.

Witnesses:
JOHN W. GIBBONEY,
BENJAMIN B. HULL.