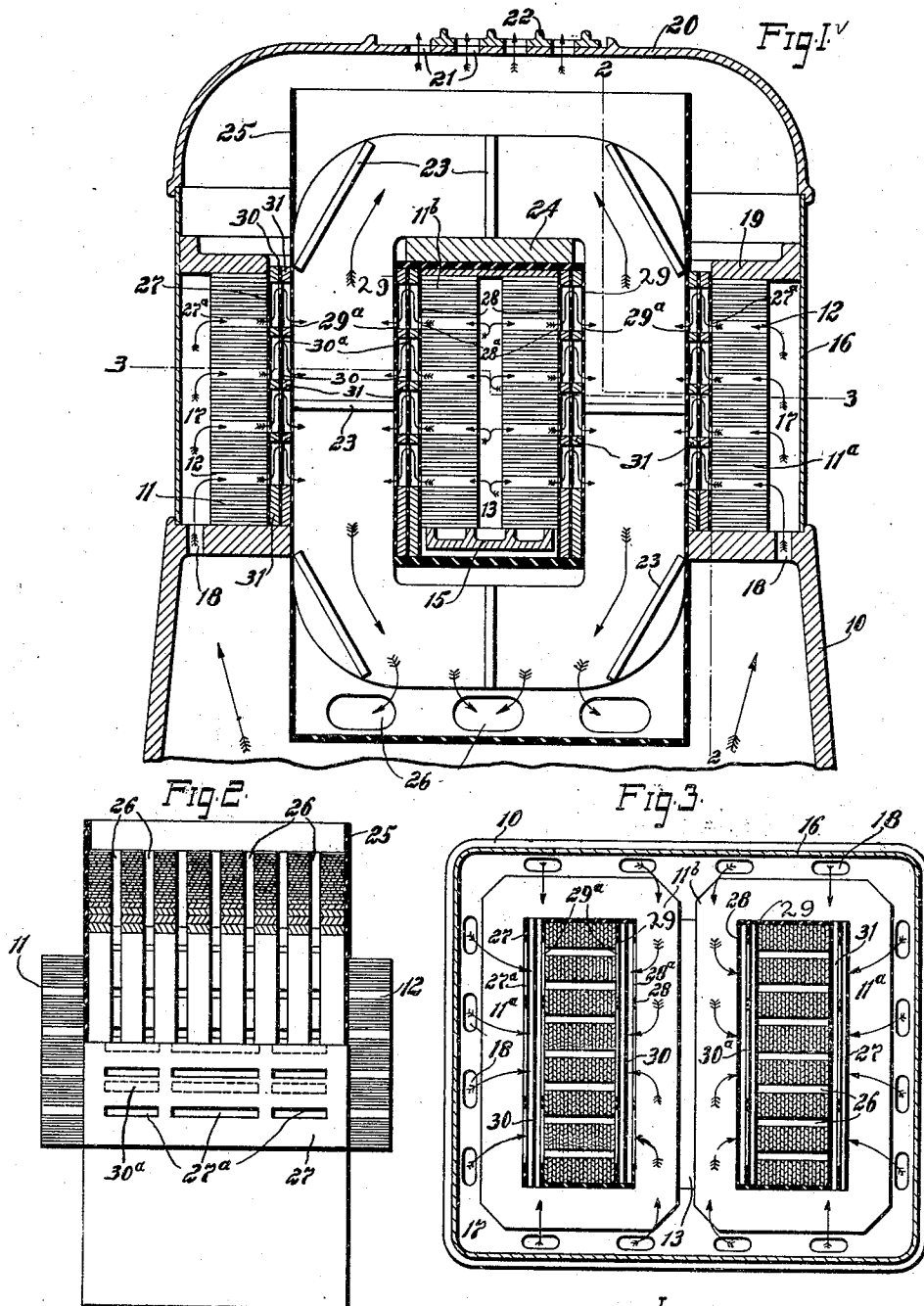


No. 834,160.

PATENTED OCT. 23, 1906.

L. C. NICHOLS.  
TRANSFORMER.

APPLICATION FILED OCT. 19, 1905.



WITNESSES:

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LOUIS C. NICHOLS, OF NORWOOD, OHIO, ASSIGNOR TO THE BULLOCK ELECTRIC MANUFACTURING COMPANY, A CORPORATION OF OHIO.

## TRANSFORMER.

No. 834,160.

Specification of Letters Patent.

Patented Oct. 23, 1906.

Application filed October 19, 1905. Serial No. 283,534.

*To all whom it may concern:*

Be it known that I, LOUIS C. NICHOLS, a citizen of the United States, residing at Norwood, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Transformers, of which the following is a full, clear, and exact specification.

My invention relates to transformers for alternating currents; and one of the objects of my invention is to provide an improved ventilating means whereby both the core and coils will be effectively cooled.

Another object is to so arrange the insulating-sheets and the ventilating-openings between the core and coils that there will be little surface leakage.

In carrying out the first part of my invention I so arrange the passage-ways in the core and between the coils that a forced circulation of air can be maintained through the passage-ways in the core and then through the passage-ways between the coils in two different directions.

In carrying out the second part of my invention I separate the coils from the core by air-spaces and provide leakage-surfaces greater than the spaces between the coils and the core.

In another aspect my invention consists in a transformer provided with horizontal passage-ways, primary and secondary coils having vertical passage-ways, the passage-ways being so connected and arranged that air may be forced through the upper half of the core and upwardly through the upper portions of the coil passage-ways and through the lower half of the core and downwardly through the lower portions of the coil passage-ways, whereby two independent circulations of air may be maintained through the core and coils.

My invention still further consists in the details of construction and combinations of elements described in the specification and set forth in the appended claims.

For a better understanding of my invention reference is had to the accompanying drawings, in which—

Figure 1 is a vertical sectional view of my transformer. Fig. 2 is a section on a reduced scale along the line 2 2 of Fig. 1, and Fig. 3 is a section on a reduced scale along the line 3 3 of Fig. 1.

Referring to the figures of the drawings, 10 indicates a cast-metal base on which my transformer is supported. The core 11 of the transformer consists of groups of laminae spaced apart, forming horizontal ventilating passage-ways 12. The core is divided into two portions, which are spaced apart, forming the passage-way 13. The outer legs 11<sup>a</sup> of the core rest directly on the base and the inner adjacent legs 11<sup>b</sup> rest on the transverse support 15.

Supported on the base is the rectangular casing 16, which is somewhat larger than the core, and is spaced therefrom on all sides, leaving the continuous passage-way 17, which communicates with the opening in the base by a large number of air-inlet openings 18, distributed along all sides of the horizontal supporting-wall of the base. The usual end head or plate 19 rests on the top of the core and against the walls of the casing 16. A cap or head 20 rests on the top of the casing 16. This cap is provided with a number of air-outlet openings 21, the size of which may be regulated by the gate or slide 22.

The primary and secondary windings are made of strap-copper and are divided in a number of sections spaced apart by strips of wood 23, forming the vertical air passage-ways 26. The coils, as is seen from the drawings, surround the inner legs 11<sup>b</sup> of the core and are supported on the transverse wooden block 24, which rests on the core.

The coils are surrounded by a closely-fitting insulating shell or casing 25, open at the top and closed at the bottom except for a plurality of lateral air-outlet openings 26', which communicate with the outside. The inner sides of the legs 11<sup>a</sup> of the core are lined with sheets of insulating material 27, and the inner sides of legs 11<sup>b</sup> are lined with sheets 28. The inner sides of the legs of the coils are also lined with sheets of insulating material 29. It is seen that the legs of the coils are smaller than the openings in the core and that the coils are separated from the inner legs 11<sup>b</sup> and outer legs 11<sup>a</sup> by equal air-spaces. The distance of the coils from the core must be sufficient to prevent leakage and will depend in each case on the voltage for which the transformer is intended. The sheets of insulation 27 and 28 lining the inner sides of the legs of the core are provided with long parallel passage-ways or slots 27<sup>a</sup> and

28<sup>a</sup>, which slots aline with the passage-ways 12 in the core. The insulating-sheets 25 and 29, surrounding the legs of the coils, are in a similar manner provided with slots 29<sup>a</sup>, which are directly opposite the passage-ways 12 in the core and the slots 27<sup>a</sup> and 28<sup>a</sup> in the insulating-sheets 27 and 28.

In order to increase the leakage-surface between the coils and core, I provide in the spaces between the core and coils barriers 30 of insulating material held at equal distances from the core and coils by wooden strips 31. The barriers are provided with ventilating-slots 30<sup>a</sup>, which are out of alignment with or staggered with respect to the slots in the insulating-sheets on each side. This is clearly shown in the drawings.

In Fig. 2 the dotted rectangles indicate the slots in the separating sheets or barriers 30. It is well known that leakage will take place between two points or surfaces of different potentials much more easily along a surface even if the surface is of good insulating material than directly through an insulating medium, as air. It is therefore necessary to increase as much as possible the leakage-surface directly between the points of different potentials. By staggering the slots in the insulating-sheets it will be seen that the leakage-surface between the slots 27<sup>a</sup> and 29<sup>a</sup> and 28<sup>a</sup> and 29<sup>a</sup> in the sheets lining the coils and cores will be greatly increased.

The directions of the air-currents through the transformer are as follows: Air from any suitable fan or blower is forced under considerable pressure into the base 10 through the openings 18 into the passage-ways 17 and 13, from which passage-ways the air passes through all the horizontal spaces or passage-ways 12 between the group of laminae of the core. From the passage-ways 12 the air passes by the irregular paths through the openings in the insulating-sheets into the vertical spaces between the coil-sections. The spacing-strips of wood 23 serve as barriers to divide the air-currents and direct the latter so that all the air which enters the spaces between the coils through the upper openings 12 in the core passes upward and out of the casing at the top, while all the air which enters through the lower openings 12 passes downward and escapes from the casing through the openings 26<sup>a</sup>.

It will be seen that by providing two different paths for the air-currents through the spaces between the coils the latter will be maintained at a lower temperature than if the air after passing through the core was forced along the entire length of the coils.

I aim in my claims to cover all modifications and changes which do not depart from the spirit of my invention.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a transformer, a core provided with

ventilating passage-ways, primary and secondary coils having ventilating passage-ways, the passage-ways in the core and coils being so connected and arranged that air can be forced through the passage-ways in the core and then through the passage-ways between the coils in two different directions.

2. In a transformer, a core provided with passage-ways, primary and secondary coils having passage-ways, the passage-ways in the core and coils being so connected and arranged that a cooling medium can be forced first through the passage-ways in the core and then by divided paths through the passage-ways in two different portions of the coils.

3. In a transformer, a core provided with ventilating passage-ways, coils divided into sections separated from each other forming ventilating passage-ways, the passage-ways being so connected and arranged that air can be forced through the passage-ways in one part of the core and through the passage-ways between the coils for part of their length, and through another part of the passage-ways in the core and through the passage-ways between the coils for another part of their length.

4. In a transformer, a core provided with passage-ways, primary and secondary coils provided with passage-ways, part of the passage-ways in the core communicating with a part of all the passage-ways in the coils, and the other passage-ways in the core communicating with another part of all the passage-ways in the coils, whereby one-half the core and parts of the coils, and the other part of the core and the other parts of the coils can be cooled independently.

5. In a transformer, a core provided with horizontal passage-ways, primary and secondary coils having vertical passage-ways, the horizontal passage-ways in the upper part of the core communicating with the passage-ways between the upper part of the coils and the passage-ways in the lower part of the core communicating with the passage-ways between the lower parts of the coils.

6. In a transformer, a core, primary and secondary coils thereon, insulating-spaces between the core and coils and means for providing a leakage-surface between the core and coils greater than the widths of the insulating-spaces.

7. In a transformer, a core, primary and secondary coils thereon, said core and coils having communicating ventilating-openings, and an insulating-barrier between the openings for providing a large leakage-surface between the coils and core.

8. In a transformer, a core having ventilating passage-ways, primary and secondary coils having ventilating passage-ways, said coils being mounted on, but spaced from, the

legs of the core, a plurality of spaced insulating-sheets in the spaces between the core and coils, said sheets having openings or perforations staggered with respect to each other whereby a large leakage-surface is provided.

5 9. In a transformer for alternating currents, a core provided with ventilating passage-ways, primary and secondary coils mounted on the core, said coils being spaced  
10 from each other and from the core forming ventilating passage-ways at right angles to the passage-ways in the core, insulating-barriers located in the spaces between the core and the coils, said barriers having open-  
15 ings staggered with respect to the openings leading from the passage-ways in the core to the passage-ways in the coils, and barriers located in the passage-ways between the coils, the said passage-ways in the upper  
20 part of the core communicating with the portions of the passage-ways above the last-named barriers, and the passage-ways in the lower part of the core communicating with the portions of the passage-ways below said  
25 last-named barriers, whereby two circula-

tions of air may be maintained through the core and coils independently of each other.

10. In a transformer for alternating currents, a core provided with ventilating passage-ways, primary and secondary coils 30 mounted on the core, said coils being spaced from each other and from the core forming ventilating passage-ways at right angles to passage-ways in the core, and barriers located in the passage-ways between the coils, the 35 said passage-ways in the upper part of the core communicating with the portions of the passage-ways above the barriers, and the passage-ways in the lower part of the core communicating with portions of the passage- 40 ways below the barriers, whereby two circulations of air may be maintained through the core and coils independently of each other.

In testimony whereof I affix my signature in the presence of two witnesses.

LOUIS C. NICHOLS.

Witnesses:

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ARTHUR F. KEVIS.