No. 873,166. PATENTED DEC. 10, 1907.

L. C. NICHOLS.

TRANSFORMER.

APPLICATION FILED JAN. 15, 1906.

3 SHEETS—SHEET 1.

Fig. 2.

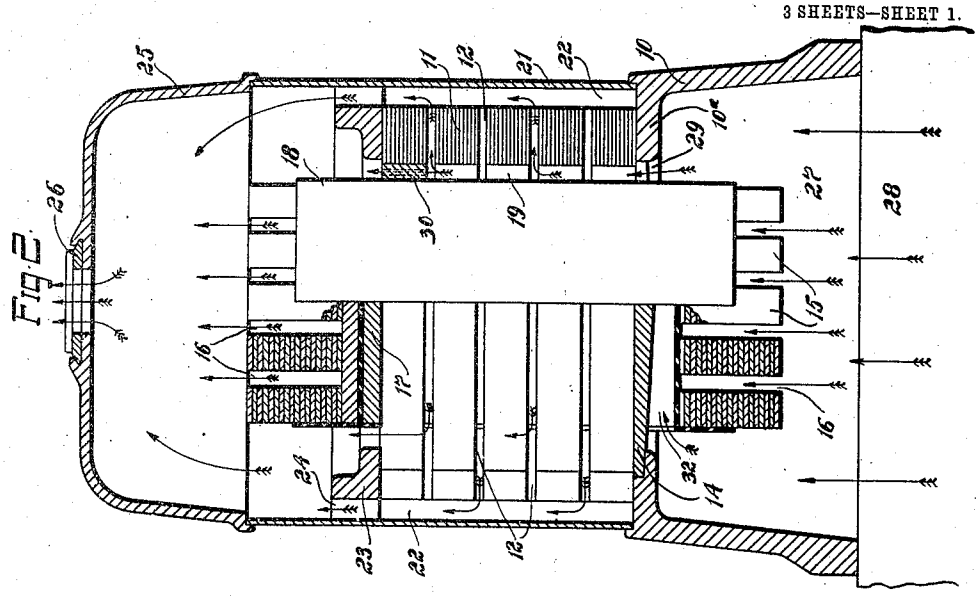
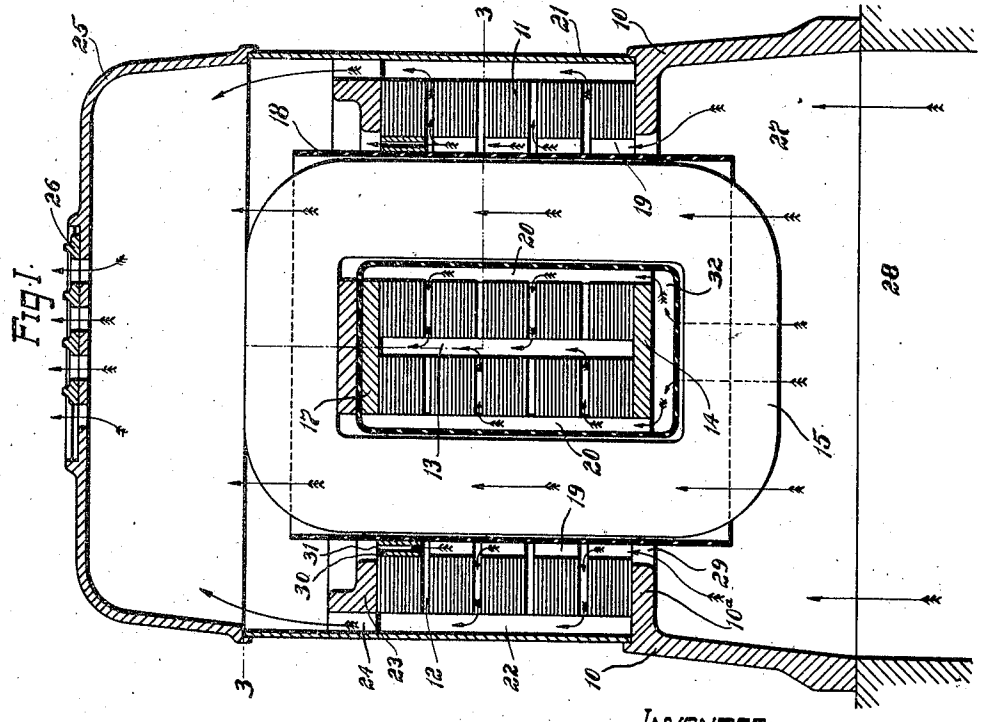


Fig. 1.



WITNESSES:

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3 SHEETS—SHEET 2.

Fig. 3

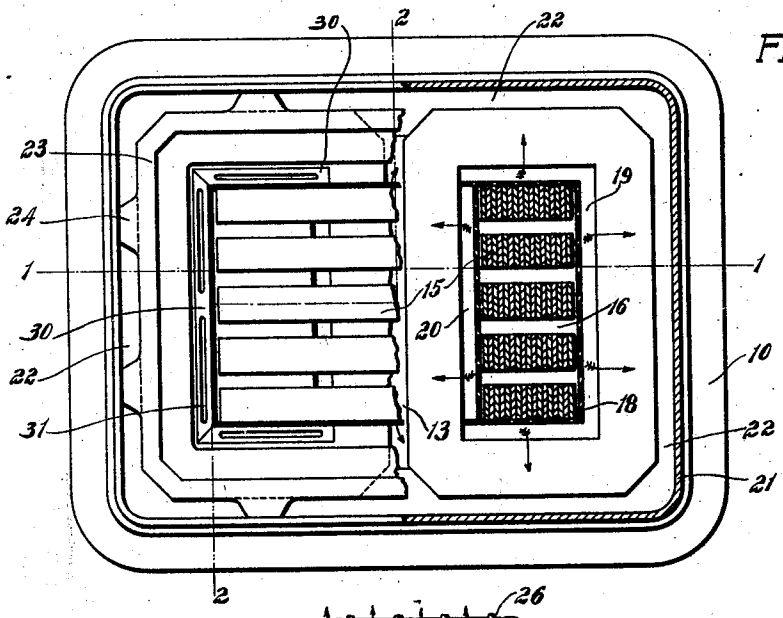
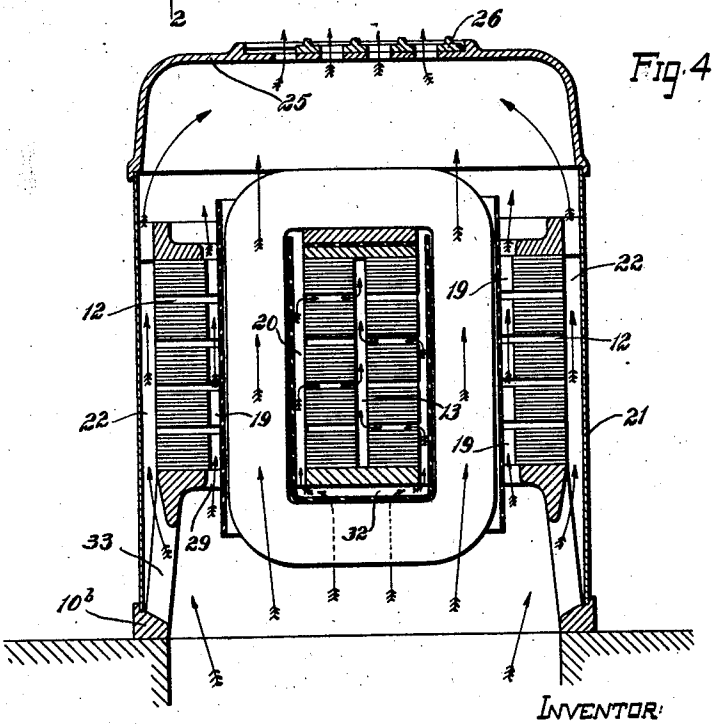


Fig. 4



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3 SHEETS—SHEET 3.

Fig. 5.

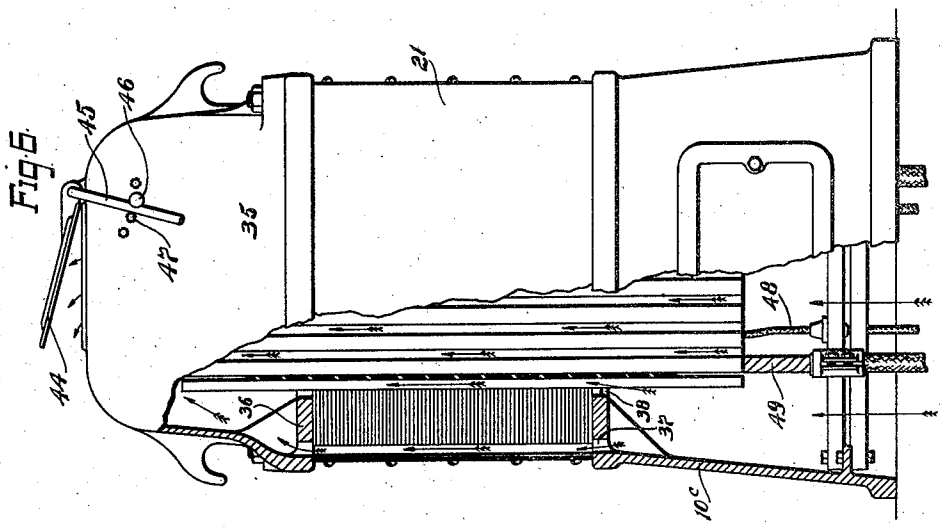
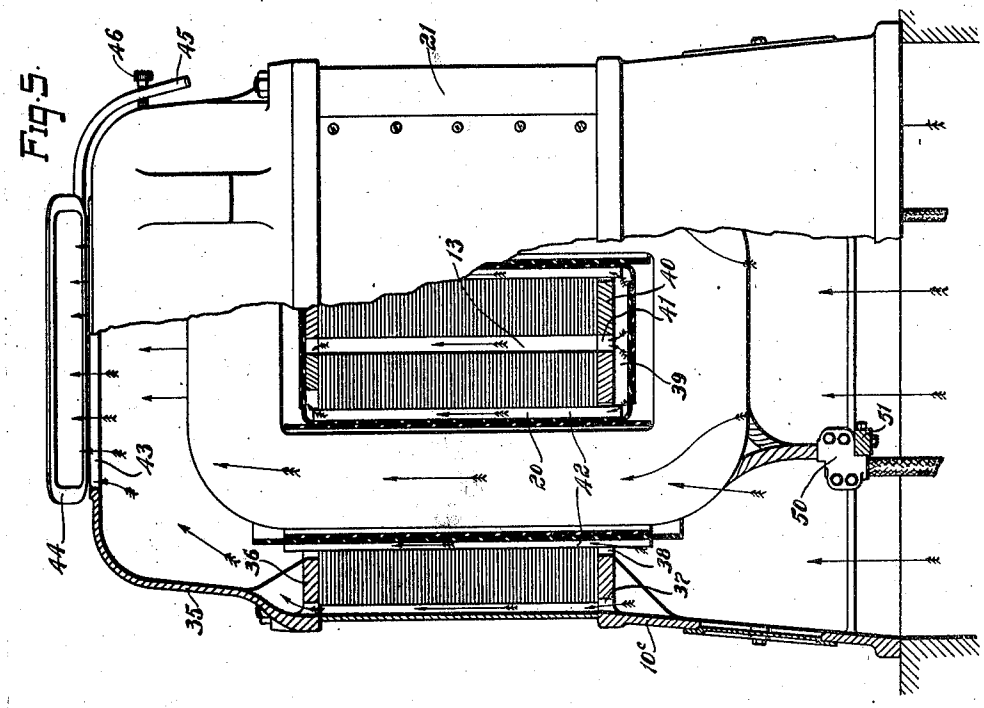


Fig. 5.



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UNITED STATES PATENT OFFICE.

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

TRANSFORMER.

No. 873,166. Specification of Letters Patent. Patented Dec. 10, 1907.

Application filed January 15, 1906. Serial No. 296,058.

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 and especially to the cooling means for transformers having a very large kilowatt capacity. In such devices, means must be provided for carrying away the heat generated therein to prevent a dangerous rise of temperature.

The object of my invention is to provide an air blast cooling system which will be effective for transformers of any kilowatt capacity.

I employ a forced circulation of air for cooling the parts of the transformer, and my invention consists in so arranging the air-ducts or air passageways through the transformer that all parts will be effectively cooled.

My invention still further consists in the details of construction and combinations of elements described in the specification and definitely 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 section through a transformer having my invention applied thereto, along the line 1—1 of Fig. 3; Fig. 2 is a vertical section along the line 2—2 of Fig. 3; Fig. 3 is a section along the line 3—3 of Fig. 1; Fig. 4 is a vertical section similar to Fig. 1, on a reduced scale, of a transformer embodying a modified form of my invention; and Figs. 5 and 6 are side and end view respectively with parts in section, showing a further modification of my invention.

Referring first to Figs. 1, 2 and 3 of the drawing, I have shown at 10 a cast metal transformer stand on which are mounted transformer cores 11. Each core consists of laminæ which in Figs. 1, 2 and 3 are arranged in groups, the latter being spaced apart, forming horizontal passageways 12. The two cores are spaced apart leaving a vertical air space 13. The outer sides or legs of the transformer cores rest upon the horizontal ledge 10^a of the stand, and the inner or adjacent sides or legs rest upon a brass plate 14, the ends of which are supported on opposite sides of the transformer stand as in the customary manner.

Surrounding the inner adjacent portions of the two cores are the primary and secondary coils 15, which are arranged in sections spaced apart, forming vertical air passageways 16. The coils rest upon one or more wooden blocks 17, and are surrounded by an insulating casing or sheath 18. This sheath extends a short distance above and below the cores and is open at its upper and lower ends. The cores and coils are so proportioned that the open spaces in the cores are larger than the legs of the coils, and the coils are so arranged that the vertical portions are located centrally of the openings in the cores and are therefore spaced on all sides from the sides of the cores. The spaces are preferably left open and form vertical air passageways 19 between the coils and the outer portions of the cores, and vertical passageways 20 between the coils and the inner or adjacent portions of the cores. The coils may be held in place in any desired manner by blocks of wood or other insulating material.

The transformer is surrounded by a casing 21 made preferably of sheet metal. This casing is slightly larger than the transformer and is spaced therefrom on all sides, forming a continuous air passageway 22. As shown in Fig. 3, the end plate 23 is provided with lugs 24 which engage the sides of the casing. The casing is provided at its upper end with a cap 25 having a plurality of air outlet openings, the size of which can be regulated by the movable gate 26.

The transformer stand or base 10 is provided with an open space 27, and is seated over a large air inlet opening 28 in the supporting floor or foundation. While I have shown the transformer seated over the air inlet opening 28, it is evident that the opening 27 in the stand could have communication with a source of air supply in any other convenient manner. The opening in the stand, through which the lower portions of the coils extend, is of sufficient size to provide air openings 29 which communicate with the vertical air passageways 19. As is clearly shown in the drawing, the upper parts of the vertical passageways 19 are provided with insulating blocks 30 having narrow openings 31. Thus the upper parts of the passageways 19 are more restricted than the upper parts of the passageway 22. As shown

in Figs. 1 and 2, there is an open space 32 between the lower portions of the coils and the supporting plate 14, whereby air may pass from the opening 27 in the stand, into the vertical passageways 20.

The paths of the air currents through the transformer, indicated by the arrows in the different figures, will now be pointed out. Air may be brought under any desired pressure from a suitable fan or blower through the opening 28 into the opening 27 of the transformer stand. From the opening 27 the air may pass through the transformer by a variety of paths. The air may flow freely upward through the passageways 16 between the sections of the coils and a sufficient amount of air will pass through these passageways to prevent an undesirable rise of temperature. The air currents also pass through the openings 29 into the vertical passageway 19 between the legs of the coils and the outer portions of the cores. The air rises in these passageways and a large portion passes through the horizontal passageways 12 of the outer portions of the cores into the vertical passageway 22 between the cores and the casing, through which the air passes to the upper part of the casing above the transformer. A portion of the air may also pass directly upward along the vertical passageway 19 and through the restricted openings 31, to the upper portion of the casing and through the outlet openings.

The relative amounts of air which pass through the horizontal passageways 12 and the restricted openings 31 can be changed by changing the size of the openings 31 in the block 30. As is shown in Figs. 1 and 2, air also passes into the space 32 between the lower portions of the coils and the supporting block or plate 14, and enters the vertical passageways 20 between the legs of the coils and the adjacent portions of the cores. From these passageways 20 the air may pass through the horizontal passageways 12 in the inner portions of the cores into the vertical air space 13 and upward, and then laterally to the passageway 22 between the cores and the casing.

It is seen that the air currents have access to all parts of the transformer and therefore there will be no tendency for any part to become overheated. The amount of air blown through the transformer may be regulated by adjusting the size of the outlet openings in the upper part of the casing 25 by means of the gate 26. Although I have shown openings 31 in the blocks 30 of the upper portions of the passageway 19, it is evident that I may close entirely the upper portion of the passageways 19 so that all the air that enters said passageways must pass through the horizontal passageways 12, to the vertical passageway 22 between the casing and the outer portions of the cores.

In Fig. 4 I have shown one modification of my invention. The transformer stand 10^b is not only provided with openings 29 leading to the passageways 19, but is also provided with openings 33 leading directly to the passageway 22 between the casing and the outer portions of the cores. In this construction the openings leading from the upper part of the passageways 19 to the upper part of the casing are not restricted. Therefore the air will pass upward equally through the passageways 19 and 22 on both sides of the outer portions of the cores. As the air pressure in both passageways is the same there will be no tendency for the air to pass through the horizontal passageways 12.

In Figs. 5 and 6 I have shown a commercial form of a transformer, involving a further slight modification in the casing and arrangement of the air passageways. In this case the cores of the transformer are not provided with the horizontal passageways shown in the other figures, but are cooled entirely by the circulation of air through the vertical passageways. A slightly modified form of stand is shown at 10^c. As in the previously described constructions, the stand supports a sheet metal casing. Resting on the casing is a cast metal cap 35, which has a horizontal ledge 36, which rests on the top of the laminæ. The stand is provided with openings 37 and 38 which communicate with the vertical passageways between the coils and the outer portions of the cores, and between the outer portions of the cores and the casing, which vertical passageways communicate with the space above the cores through suitable openings. As in the other constructions an open space 39 is provided between the plate 40, which supports the inner legs of the two cores, and the insulating sheath. The plate 40 is, in this case, provided with a number of openings 41 between the inner adjacent portions of the core, or two separate plates may be employed, which plates are spaced apart so that air can rise directly into the vertical space between the two cores. The air therefore passes from the opening 39 to the vertical passageways 20 between the coils and the inner portions of the cores, and also to the space 13 between the two cores. The air is preferably guided upward by vertical strips of wood 42. The air after rising to the upper part of the cores passes laterally from the vertical passageways 13 and 20 to the space in the casing cap. The cap is provided with an air outlet opening 43, which may be closed by a hinged lid or door 44. This door has a handle 45 adapted to engage a pin 46 which may be inserted in any one of a series of holes 47. By inserting the pin in different holes, the opening may be more or less closed by the lid. The high and low tension terminal leads are shown at 48 and 49 respectively. These leads are connected to

terminal blocks 50 mounted on horizontal supporting strips 51. It is seen that the passageways and therefore the paths of the air currents may be varied to a considerable extent.

I aim in my claims to cover all modifications which do not involve a departure from the spirit and scope of my invention.

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

1. In a transformer, a laminated core, coils thereon, and a casing surrounding the core and coils, the parts being so provided with passageways that air can be forced from the bottom to the top of the casing between the coils, between the core and coils, and between the casing and the parts incased therein.

2. In a transformer, a laminated core, coils separated by passageways, and a casing surrounding the core and coils, the parts being so constructed and arranged that there are vertical air passageways between the core and coils and between the core and casing, all said passageways communicating with an air inlet opening at the bottom of the casing, and an air outlet opening at the top of the casing.

3. In a transformer, a laminated core provided with a plurality of air passageways, primary and secondary coils, and a casing surrounding said core and coils, the whole being so constructed that air can be forced in a general upward direction, between the core and coils, between the core and casing, and through said air passageways whereby all parts will be well cooled.

4. In an air blast transformer, a transformer base, a laminated core mounted thereon, said core having a plurality of passageways between the core laminæ, primary and secondary coils, said coils being divided into sections and separated by air passageways, and a casing surrounding the core and coils, the parts being so constructed that air can be forced in a general upward direction through the passageways between the coils, between the core and coils, between the core and casing and through said passageways between the core laminæ, whereby all parts can be effectively cooled.

5. In a transformer, a base or stand, a laminated core thereon, said core being provided with ventilating passageways between the laminæ, primary and secondary coils provided with ventilating passageways, an insulating casing or sheath surrounding the coils and open only at the top and bottom, and a casing surrounding the core and coils, said stand being seated over or otherwise provided with an air inlet opening and said casing being provided at the upper end with an air outlet opening, the whole being so constructed that air can be forced in a general upward direction through the coils, between the core and coils, between the core and casing and through the passageways in the core laminæ.

6. In an air blast transformer, a laminated core, primary and secondary coils surrounding portions of said core, a stand on which the core and coils are mounted, and a casing surrounding the core, said stand being seated over an air inlet opening, and said casing having an air outlet opening at the top, the parts being so constructed that there are passageways leading from the air inlet opening to the air outlet opening, through the coils, between the core and coils, and between the core and casing.

7. In an air blast transformer, two laminated cores separated by a vertical air space, primary and secondary coils surrounding the adjacent portions of said cores and having ventilating air passageways, and a casing surrounding the transformer, said casing having air inlet and air outlet openings, the parts being so constructed and arranged that air can be forced upward between the coils, through the space separating the cores, between the core and coils and between the core and the casing.

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

LOUIS C. NICHOLS.

Witnesses:

ARTHUR F. KWIS,

FRED J. KINSEY.