June 24, 1930. J. KUBLER 1,766,654

TRANSFORMER COOLING APPARATUS

Filed Oct. 28, 1927

Fig. 1.

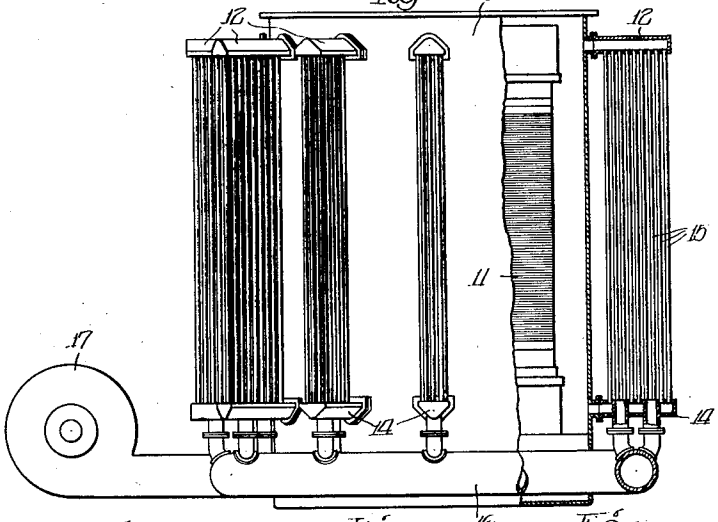


Fig. 2.

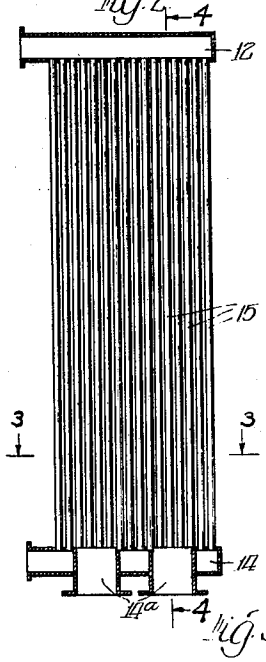


Fig. 4.

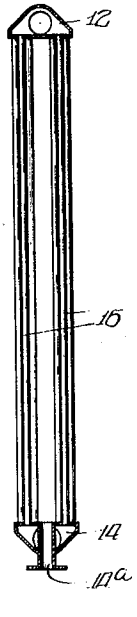


Fig. 5.

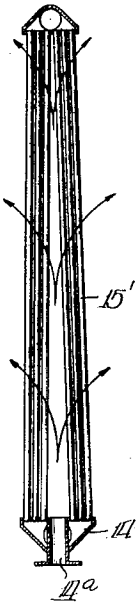


Fig. 6.

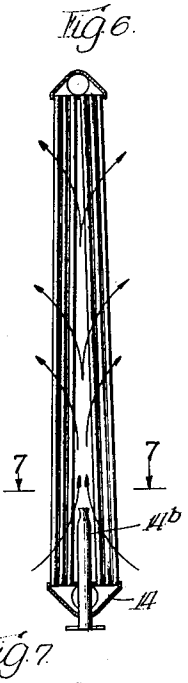


Fig. 3.

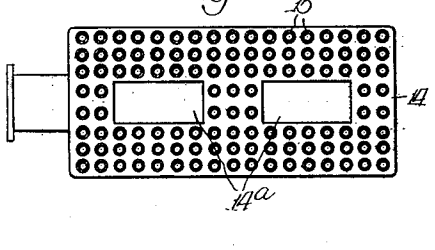
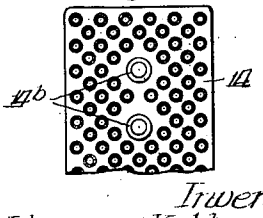


Fig. 7.



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UNITED STATES PATENT OFFICE

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TRANSFORMER COOLING APPARATUS

Application filed October 28, 1927, Serial No. 229,303, and in Germany November 13, 1926.

This invention relates to electrical transformers and pertains particularly to the cooling of such apparatus.

A general object of the invention is the provision of a cooling arrangement whereby the cooling effect may be augmented without necessitating increase of the amount of heat transfer surface.

Another object is the provision of apparatus for obtaining a forced draft cooling of transformer radiators whereby to obtain maximum cooling effect with minimum handling of cooling air.

Another object is the provision of forced draft cooling apparatus which will obtain uniform cooling effect among different radiators.

A further object is the provision of a forced draft cooling apparatus for transformers which is adapted for use with oil circulating containers of various commercial forms and which does not encumber the container or involve elaborate auxiliary features.

Other and further objects will be pointed out or indicated hereinafter or will appear to one skilled in the art upon an understanding of the invention or its employment in practice.

In the drawing forming a part of this specification, I illustrate one form in which the invention may be embodied, together with various modified details, but it is to be understood that these are presented for purpose of illustration only and are not to be interpreted in any fashion for limiting the claims short of the true and most comprehensive scope of the invention in the art.

In the drawing,

Figure 1 is an elevational view, partly in sectional elevation, of an apparatus containing the invention;

Fig. 2 is a detail in the nature of a longitudinal sectional elevation of one form of radiator;

Fig. 3 is an enlarged sectional view, the section being taken on the line 3—3 in Fig. 2;

Fig. 4 is a sectional view, the section being taken on the line 4—4 in Fig. 2;

Fig. 5 is a view similar to Fig. 4, showing a modified form;

Fig. 6 is a view similar to Fig. 4, showing a second modified form; and

Fig. 7 is an enlarged sectional view, the section being taken on the line 7—7 in Fig. 6.

As is well known in the art, it is customary to provide the tanks or casings in which electrical apparatus, such as a transformer, is housed, within a body of oil, with external radiators which are exposed to air and have communication with the tank to accommodate the circulation of oil through the radiators, wherein it is cooled by the conduction of the heat through the radiator walls to the surrounding air. Various expedients have been arranged for promoting circulating of air through or about the radiators, but those heretofore proposed, so far as I am aware, have involved the handling of large quantities of air, and have not been particularly well adapted to produce uniform cooling effect on all of the radiators connected with the tank. By the present invention, the circulation of cooling air on the several radiators is equalized, and the amount of air which it is necessary to handle by a blower, compressor, or the like, is not such as to necessitate a large pump, in order to attain the desired cooling effect.

The nature of the invention will be ascertained by a consideration of the illustrative forms shown in the drawing. In the embodiments illustrated in Fig. 1, the reference numeral 10 designates the transformer tank or casing in which the transformer 11 is housed, within a body of oil. The casing is provided with external radiators, comprising upper headers 12 and lower headers 14 mounted thereon and communicating with the interior thereof, and tubes 15 connecting the headers. Thus oil from within the casing may enter the upper header, pass downwardly through the tubes 15 to the lower header 14, being cooled meanwhile, and enter the lower portion of the casing. The radiators illustrated in Fig. 1 are arranged in a radial or outstanding position on the sides of the casing, but such arrangement is not

essential to the invention. The radiators are exposed to air for the cooling effect. To increase the circulation of air in contact with the heat transfer surfaces of the radiators, and thereby increase or expedite the cooling effect, I provide for a forced circulation of air through the radiators and a suitable distribution of such air to the different radiators. For example, in the construction illustrated in Figs. 1 to 4 inclusive, the lower headers are provided with the air inlets or passages 14^a, about which the tubes 15 are distributed, which air inlets are connected with a suitable conduit 16 which is supplied with air under pressure from a suitable compressor or blower 17. Thus air is forced upwardly through the interior of the radiator, with the result that air circulation in contact with the tubes 15 is materially increased. The air thus circulated in contact with the tubes is not only that which is injected through the passages 14^a, but also air which is about the tubes and which is entrained or set in motion by the injected air. The forced circulation of the air in the upward direction is in accordance with the natural direction of movement of the air as it is heated, the forced draft thus augmenting and expediting the natural travel of the air. The movement of the air upwardly from the lower portions of the radiators likewise tends to promote the circulation of oil in the normal direction, viz., downwardly through the radiators, as with the most rapid cooling at the lower portion of the radiators, there is not the likelihood of counterdirectional convection currents within the tubes. Thus a more rapid circulation of the oil through the container and the radiators is promoted.

In the construction illustrated in Fig. 5, it will be observed, the radiator tubes 15′ at opposite sides of the air inlet 14^a are arranged so as to converge upwardly, so as to afford an upwardly contracting air path between them, which is calculated to give uniform distribution of air along the length of the tubes.

For the purpose of increasing the entraining action of the injected air, the air inlets may be arranged in the form of nozzles 14^b, as illustrated in Fig. 6, said nozzles extending to some distance above the lower headers, so as to produce a very decided entraining effect.

The invention claimed is:

1. In transformer cooling apparatus, a casing, a radiator unit comprising a plurality of vertically disposed laterally spaced tubular elements communicating at their upper and lower ends with the interior of said casing, a fluid discharge member disposed at one end of said unit intermediate said elements and arranged to direct cooling fluid in a direction substantially longitudinally of said unit from said end thereof toward the opposite end of the same, said elements converging in said direction to form a contracting passage for said fluid, and means for supplying cooling fluid under pressure to said member for discharge therefrom in said direction.

2. In transformer cooling apparatus, a casing, a radiator unit comprising an upper and a lower header, both of said headers being in communication with said casing, laterally spaced tubular elements joining said header, said elements being arranged to enclose an upwardly converging space, a nozzle for discharging a cooling fluid supplied thereto under pressure, said nozzle extending through said lower header and being arranged substantially parallel with the axis of said elements.

In testimony whereof I have hereunto subscribed my name this 11 day of October, A. D. 1927, at Zurich, Switzerland.

JOHANNES KUBLER.