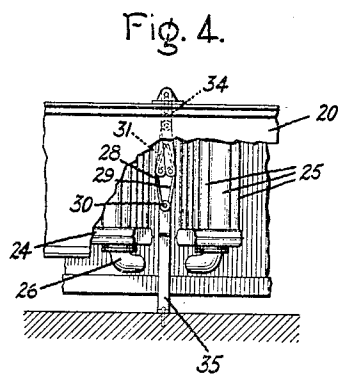
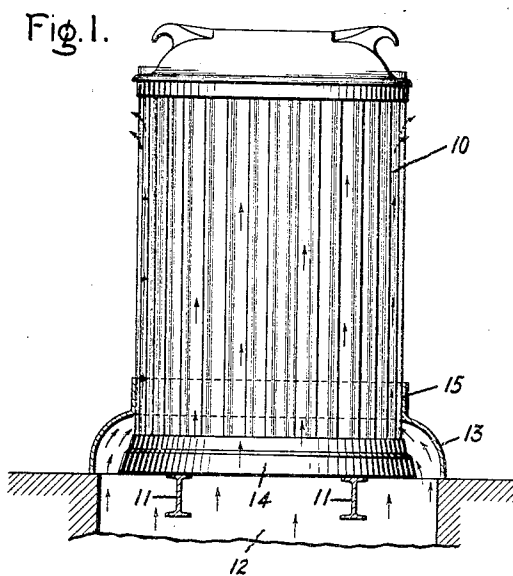
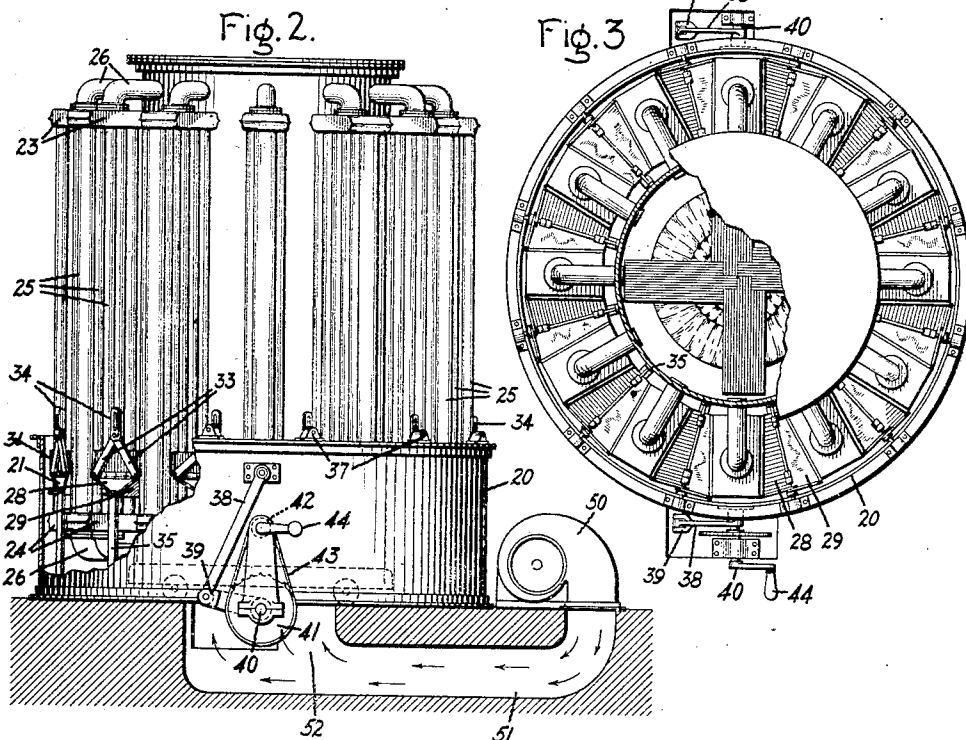


V. M. MONTSINGER:
COOLING ELECTRICAL APPARATUS.
APPLICATION FILED JUNE 28, 1917.

1,275,972.

Patented Aug. 13, 1918.



Inventor:
Vincent M. Montsinger,
by *Alfred H. Davis*
His Attorney.

UNITED STATES PATENT OFFICE.

VINCENT M. MONTSINGER, OF PITTSFIELD, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

COOLING ELECTRICAL APPARATUS.

1,275,972.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, VINCENT M. MONTSINGER, a citizen of the United States, residing at Pittsfield, in the county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Cooling Electrical Apparatus, of which the following is a specification.

My invention relates generally to electrical apparatus, but particularly to such electrical devices as transformers, condensers, etc., which are submerged in liquids in tanks. The object of my invention is to provide for self-cooling or artificial cooling of the same unit of such electrical apparatus as conditions may warrant, without material change in the construction of the units. By my invention the devices may be operated as self-cooled units up to certain loads and when it becomes necessary to exceed these loads, may be operated at such increased loads as artificially cooled units. Other advantages of devices embodying my invention will be understood from a further consideration thereof.

I contemplate at present that my invention will find its greatest application in connection with electrical transformers and therefore for the sake of simplicity I have hereinafter substantially confined the description of my invention to this type of apparatus. It will be recognized however that my invention is not limited to this type of apparatus but that it is applicable to various other types of electrical apparatus as indicated above.

In devices embodying my invention the electrical apparatus is submerged in oil (or other suitable submerging material) which conveys the heat developed in such apparatus to the walls of the containing tanks from which the heat is dissipated to the surrounding medium, generally the air of the atmosphere. The surfaces of the tanks are arranged to secure so much self-cooling as may be desirable and practically possible, the tanks being either smooth or provided with cooling elements as corrugations, radiators, etc. In carrying out my invention, deflectors are provided about the tanks to direct the forced flow of an external cooling fluid during artificial cooling, air will generally be found to be the most suitable fluid for this purpose. The deflectors direct any air (or other suitable cooling fluid; for simplicity substantially only air will be referred

to hereinafter) that may be forced through them into paths in fairly close contact with the tank surfaces and the surfaces of any corrugations, radiators or other cooling elements that may be provided on the tank surfaces. Generally this external cooling fluid will be directed upwardly into substantially vertical paths and the deflectors will be located about the lower ends of the tanks. Such deflectors I have found need extend vertically along the tank surfaces substantially only sufficiently far to initially direct the air into its proper course, and that thereafter the air will continue substantially in close contact with the tank surfaces for considerable distances. The distances these deflectors extend along the tank surfaces being very short, the deflectors do not interfere with the effective self-cooling of the unit when there is no forced flow of the air and hence the deflectors may be permanently attached to or about the units. Such units may therefore be operated as self-cooled units of certain capacities, or as units of increased capacities by forcing air under some pressures, for example, $\frac{1}{4}$ to $\frac{1}{2}$ ounce per square inch, between the deflectors and the tank surfaces, this forced flow of the air materially increasing the rate of heat dissipation from the tank surfaces.

By way of example I may indicate that for simple corrugated oil filled tanks in the neighborhood of eight feet high, I have found that deflectors engaging the outer edges of the corrugations adjacent the lower ends of the tanks, operate effectively under forced air flow while extending approximately but ten inches vertically along the corrugations, and that the devices provided with air deflectors of such length operate efficiently as self-cooled units when no air is forced through the deflectors.

When the tank surfaces are smooth or are of simple corrugations, deflectors permanently fastened in place around the lower ends of the tanks will undoubtedly generally be found sufficient. In some cases, however, it may be found of sufficient advantage to so mount the deflectors that they may move vertically a short distance along the tank surfaces in order to open the lower ends of the tanks to the atmosphere and thus create somewhat longer drafts when self-cooling; when a forced flow of air is used the deflectors may be held in a lower position to pre-

vent the escape of the flowing air to the atmosphere below the deflectors. Where the tank surfaces comprise a number of widely separated cooling elements or cooling elements widely separated from the tank, for example, compound corrugations and radiators, it will be found to some advantage to so arrange the deflectors as to, in effect, block off portions of the spaces between the radiating elements (or between the radiating elements and the tanks) to more effectively direct the air into contact with the radiating elements and to more effectively use all the air that is forced to flow through the deflectors.

Examples of the forms of my invention referred to above, the best embodiments of my invention I now know of, are illustrated in the accompanying drawing and described in some detail in the following description. Figure 1 is an elevation partly in section of a simple corrugated tank provided with my invention in its simplest form. Fig. 2 is an elevation of a tank for electric apparatus provided with radiators and embodying my invention in a more complex form. Fig. 3 is a plan view of the device of Fig. 2, a part of the cover of the tank being broken away to show the transformer within the tank. Fig. 4 is a detail of the device of Fig. 2 showing the deflector moved from its position in Fig. 2 in order to allow for the natural cooling of the tank.

In Fig. 1 is shown a tank 10 provided with simple corrugations in its side walls. Tank 10 contains some electrical apparatus, for example a transformer, which during its operation produces heat in the well known manner. The electrical apparatus in the tank 10 is submerged in oil (or some other suitable fluid), which convectively or otherwise transfers the heat from the electrical apparatus to the walls of the tank. The tank is shown resting on two beams 11 which span a pit or passage 12 through which air (or other suitable cooling gas) can be forced, for example, as illustrated in Fig. 2. The tank is surrounded by the deflector 13 which incloses the top of the pit 12 as shown and which is curved outwardly at the bottom in order to provide for the passage of air from below the tank around the protruding base 14 thereof. Above the base 14 of the tank, the deflector engages the outer edges of the corrugation as at 15. As indicated in the drawing by the arrows, the deflector 13 directs any air that may be forced from the air pit 12 into substantially vertical upward paths in contact with the side walls of the tank 10. The deflector extends vertically along the side walls of the tank 10 substantially only so far as to initially direct the flow of the cooling gas into its proper upward path; the gas continues in this path from the deflector to adjacent the

upper end of the tank. As before indicated the vertical extent of the deflector along the side walls of the tank will vary somewhat in the different cases, but the deflector need extend but such a short distance upward along the side walls of the tank (in order to secure the desired artificial cooling effect), that the tank and its contained electrical apparatus may be operated as a self-cooled unit (that is without supplying air through the pit 12) up to a maximum load which is very nearly equal to the maximum load of the unit operating self-cooled were the deflector 13 omitted. In addition the unit may be operated at a load of from 125% to 150% of its maximum load self-cooled, by supplying air along the side walls of the tank from the air pit 12.

In the device of Fig. 2 the deflector assumes a more complicated form than in Fig. 1 due to the fact that the cooling elements are of greater size and are considerably separated from each other; further the deflector is so arranged that it may be elevated somewhat so that, during self-cooling, the air of the atmosphere may find its way into the deflector below the same and create a longer and more efficient draft. In this way a somewhat greater cooling of the tank may be obtained in some cases than were the deflector maintained in its lowermost position during the self-cooling of the unit. The deflector of Fig. 2 (see also Figs. 3 and 4) comprises as before a cylindrical member 20 surrounding the tank and the cooling elements; it also includes in this case the portion 21 between each two cooling elements. The cooling elements are radiators comprising each an upper horizontal header 23, a lower horizontal header 24, and a plurality of pipes 25 connecting the headers 23 and 24; each header is attached to the interior of the tank by a pipe 26. Each portion 21 of the deflector shown is collapsible, and comprises two vanes 28 and 29 pivoted at a common point 30. These two vanes span the space between two radiators when depressed, and are provided with portions 31 which when the vanes are in their lowermost position as shown in Figs. 2 and 3, extend vertically along the sides of the radiators for some distance and aid in initially directing the air from the air pit into the desired vertical paths. The two vanes of each deflector portion 21 are provided with two links 33 pivoted thereto and also pivoted to a common slotted vertical member 34. The vanes are carried at their common pivot point 30 by means of rods 35, one for each deflector portion 21 between the vanes and the tank and the other between the vanes and the deflector portion 20; these rods 35 may rest on the floor as illustrated in Fig. 4. The circular portion 20 of the deflector is provided with a pin 37 for rid-

ing in each of the slotted members 34 as illustrated particularly in Figs. 2 and 4. The portion 20 is also provided with or attached to two arms 38 diametrically opposite each other; these arms 38 are operated by arms 39 carried by the shaft 40 extending beneath the transformer. By means of the sprockets 41 and 42 and the belt 43, the shaft 40 may be rotated by the crank 44.

10 The interior of a deflector is provided, when desired, with air under some pressure by means of the pump 50 supplying air through the passage way 51 to the air pit 52 directly beneath the transformer tank and within the deflector therefor. The operation of the device of Figs. 2, 3 and 4 is as follows: When the electrical apparatus of the tank is to operate at a greater capacity than is possible or desirable under self-cooling, the pump 50 driven in any suitable way supplies air to the air pit 52 and from there to the interior of the deflector. The deflector, as will appear from Figs. 2 and 3, requires this air to flow substantially vertically upward and substantially in contact with the side walls of the tank and the surfaces of the radiators attached to the tank. In other words, the operation of this device under artificial cooling is substantially the same as the operation of the device of Fig. 1. When artificial cooling is to be discontinued and self-cooling is to be resorted to, the pump 50 is stopped and the crank 44 is rotated to elevate the portion 20 of the deflector to some position like that shown in Fig. 4. The elevation of this portion 20, through the coöperation of the pins 37 and the slotted members 34, results in the folding up of the vanes 28 and 29, as it were, into positions like that shown in Fig. 4. With the deflector in this upper position, the air of the atmosphere can naturally circulate from below the deflector to the interior of the same and from there upward along and between the cooling elements and the side walls of the tank. Obviously the air of the atmosphere under natural cooling can find its way to the cooling surfaces of the tank and away from those surfaces at any point along the extent of those surfaces except where the portion 20 of the deflector surrounds the device. As above indicated, the deflector extends only sufficiently far along the tank to initially direct the flow of the cooling gas along and substantially in contact with the surface of the tank during artificial cooling and thereafter the gas continues in such contact for considerable distances, preferably from the deflector to at least adjacent the end of the tank; the deflector needs to extend along the tank surfaces such a short distance, comparatively, as to interfere to substantially no, or at least to a very small extent, with the natural radiation from the tank cooling surfaces when

the cooling gas is not forced to flow thereover by the operation of the pump 50. Therefore when operating as a self-cooling unit, the unit may operate up to a capacity approaching its capacity were the deflector entirely omitted.

I contemplate that in some cases it will not be necessary to fold up the deflector portions 28 and 29 as indicated in Fig. 1 and hence in such cases the device of Figs. 2, 3 and 4 may be simplified to the extent of building the deflector portions 28 and 29 permanently into the positions shown in Fig. 2. In some cases also, as will be understood from what has gone before, it will not be necessary or to sufficient advantage to raise the deflector portion 20 during self-cooling. Where such a case is encountered the device may be simplified to that extent.

While I have described the principle of my invention and the best mode I have contemplated for applying this principle, other modifications will occur to those skilled in this art and I aim in the appended 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 of the United States, is:—

1. The combination with a tank for electrical apparatus having a medium therein for transferring heat from said apparatus to the walls of said tank for dissipating it therefrom, of a deflector permanently disposed about said tank for directing the flow of a cooling gas along and substantially in contact with the surface of the tank, and means for supplying a cooling gas to the interior of said deflector, said deflector extending along the tank surface such distances as to interfere to but a small extent with the natural dissipation of heat therefrom when the cooling gas is not forced to flow thereover from said deflectors.

2. The combination with a tank for electrical apparatus having a medium therein for transferring heat from said apparatus to the walls of said tank for dissipating it therefrom, of a deflector surrounding said tank and extending along the same substantially only sufficiently far for initially directing the flow of a cooling gas along and substantially in contact with the surface of the tank, and means for supplying a cooling gas to the interior of said deflector.

3. The combination with a tank for electrical apparatus having a medium therein for transferring heat from said apparatus to the walls of said tank for dissipating it therefrom, of a deflector surrounding the bottom of said tank and extending along the same substantially only sufficiently far for initially directing the flow of a cooling gas vertically upward along and substantially in contact with the surface of the tank, and

means for supplying a cooling gas to the interior of said deflector.

4. The combination with a tank for electrical apparatus provided on its exterior with cooling elements, having a medium in said tank for transferring heat from said apparatus to the walls of said cooling elements for dissipating it therefrom, of a deflector outside said tank and extending between adjacent cooling elements for directing the flow of a cooling gas along and substantially in contact with the surfaces of said cooling elements, and means for supplying a cooling gas to the interior of said deflector.

5. The combination with a tank for electrical apparatus provided on its exterior with cooling elements, having a medium in said tank for transferring heat from said apparatus to the walls of said cooling elements for dissipating it therefrom, of a deflector outside said tank and extending between adjacent cooling elements for directing the flow of a cooling gas along and substantially in contact with the surfaces of said cooling elements, said deflector extending vertically from adjacent the bottom of said tank substantially only sufficiently far to initially direct the cooling gas into such paths, and means for supplying a cooling gas to the interior of said deflector.

6. The combination with a tank for electrical apparatus provided on its exterior with a plurality of cooling elements, having a medium in said tank for transferring heat from said apparatus to the walls of said cooling elements for dissipating it therefrom, of deflecting means inclosing each of said cooling elements individually for directing the flow of a cooling gas along and substantially in contact with the surfaces of said cooling elements, and means for supplying a cooling gas to the interior of said deflecting means, said deflecting means extending along the tank from adjacent the bottom thereof substantially only sufficiently far to initially direct the gas flow into contact with said surfaces.

7. The combination with a tank for electrical apparatus having a medium therein for transferring heat from said apparatus to the walls of said tank for dissipating it therefrom, of a deflector surrounding said tank and extending along the same substantially only sufficiently far for initially directing the flow of a cooling gas along and substantially in contact with the surface of the tank when a cooling gas under a greater

pressure than the surrounding medium is supplied to the interior of said deflector.

8. The combination with a tank for electrical apparatus having a medium therein for transferring heat from said apparatus to the walls of said tank and dissipating it therefrom, of a movable deflector surrounding and extending along a portion only of the heat dissipating surface, and means for supplying a cooling gas coöperating with said deflector when in a predetermined position to effect artificial cooling of said apparatus.

9. The combination with a tank for electrical apparatus having a medium therein for transferring heat from said apparatus to the walls of said tank and dissipating it therefrom, of a movable deflector surrounding and extending along a portion only of the heat dissipating surface, said deflector being adapted to occupy a plurality of positions whereby said apparatus may operate either as a self-cooled unit or as an artificially-cooled unit.

10. The combination with a tank for electrical apparatus having a medium therein for transferring heat from said apparatus to the walls of said tank and dissipating it therefrom, of a movable deflector surrounding and extending along a portion only of the heat dissipating surface, means for moving said deflector into a plurality of positions and means for supplying a cooling gas to the interior of said deflector when in a predetermined position; whereby said apparatus operates as an artificially-cooled unit when said deflector is in said predetermined position and as a self-cooled unit in certain other positions.

11. The combination with a tank for electrical apparatus having a medium therein for transferring heat from said apparatus to the walls of said tank and dissipating it therefrom, of a movable deflector encircling said tank, means for supplying a cooling gas under pressure, and means for moving said deflector into one position completing an inclosure around the base of said tank for directing said cooling gas over the heat dissipating surface of said tank when connected to said source and in another position for permitting natural circulation of air over the heat dissipating surface substantially as if said deflector were absent.

In witness whereof, I have hereunto set my hand this 11th day of June, 1917.

VINCENT M. MONTSINGER.