Title: A METHOD AND AN ARRANGEMENT FOR COOLING AN APPARATUS CABINET

Abstract

The invention relates to a cooling arrangement and a method for cooling an apparatus cabinet. The cooling arrangement for cooling an apparatus cabinet comprises an apparatus cabinet (1) to be cooled and means (2) for conveying heated air out as an exhaust air flow (B) for cooling the apparatus cabinet. To reduce the noise of the exhaust air flow (B), it is essential to the invention that for reducing the noise of the exhaust air flow, the means (2) for conveying heated air out are in communication with a separate mounting base (4) beneath the apparatus cabinet (1), comprised by the cooling arrangement, for conveying heated air (B) out through an exhaust duct (4a) in said separate mounting base (4) beneath the apparatus cabinet.
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A METHOD AND AN ARRANGEMENT FOR COOLING AN APPARATUS CABINET

The invention relates to a cooling arrangement for cooling an apparatus cabinet, comprising an apparatus cabinet to be cooled and means for conveying heated air out as an exhaust air flow for cooling the apparatus cabinet.

The invention also relates to a method for cooling an apparatus cabinet, in which method air is taken in into a cooling arrangement provided in connection with the apparatus cabinet and heated air is conveyed out from the cooling arrangement as an exhaust air flow.

The present solution relates to the cooling of apparatus cabinets, particularly base station cabinets, and to reducing the noise created by the exhaust air flow in the cooling.

The electronic components comprised by the base station naturally produce heat that must be evacuated from the apparatus cabinet by means of an exhaust air flow. A heat exchanger or an air conditioning unit comprising a fan can be used to remove the heat. The exhaust air flow made up by warm air produces a sound, i.e. noise problems. Previously the base stations of cellular radio networks were large in size, and they were located in spots or spaces where there was no presence or passing by of people. With advances in the state of the art of cellular radio networks and apparatus technology, new very small base stations have entered the market, and such base stations may be located for instance on a street or in office rooms, for example, and therefore noise reduction of the exhaust air flow is a factor assuming an ever increasing importance.

To reduce the noise of the exhaust air flow, a 'noise trap' is known which is a tubular part outside the apparatus cabinet at the side of the cabinet, through which the exhaust air flow is brought out. Such solutions do not have a sufficient abating effect, and furthermore have the special disadvantage that they add to the outer dimensions of the base station, and hence the mounting of the base station requires more space and the outer appearance of base stations is impaired. With the prior solutions, it has not been possible to reduce the noise to be low enough.

The publications US 4,386,651 and US 5,467,250 disclose a conventional cooling arrangement for an apparatus cabinet, provided with an
internal circulation and an external circulation. Reference publication GB 227-7767 discloses a conventional cooling arrangement for an apparatus cabinet for a base station.

The publication JP 5-226864 discloses a normal noise trap construction comprising an absorbent material in an exhaust duct in an apparatus cabinet.

The publication US 4,644,443 discloses a normal cooling arrangement in electronics, wherein the exhaust air is discharged from the lower portion of the cabinet. The exhaust air flow is not separately conveyed in any given direction, and no actual noise trap construction is utilized, except as an absorption mat installed on the floor of the cabinet. A specific problem in said solution is that in the solution the lower portion of the apparatus cabinet forms a single unit with the actual apparatus cabinet. Thus, the apparatus cabinet and its lower portion are always dependent on one another.

It is an object of the present invention to provide a novel cooling arrangement avoiding the problems related with the prior art solutions.

This object is achieved with a cooling arrangement in accordance with the invention, which is characterized in that to reduce the noise of the exhaust air flow, the means for conveying heated air out are in communication with a separate mounting base beneath the apparatus cabinet, comprised by the cooling arrangement, for conveying heated air out through an exhaust duct in said separate mounting base beneath the apparatus cabinet.

This object is achieved with a method in accordance with the invention, which is characterized in that the exhaust air flow is conveyed out through a separate mounting base beneath the apparatus cabinet.

The cooling arrangement and method in accordance with the invention are based on the idea that a separate mounting base beneath the apparatus cabinet is utilized in reducing the noise of the exhaust air flow.

The solution in accordance with the invention affords several advantages. By means of the mounting base, the length of the blow duct of the outer circulation of the cooling apparatus can be increased by up to one metre without the outer dimensions of the base station and the cooling apparatus being changed. This increase in the length of the duct achieves a considerable reduction of the noise level, as much as 3-5 dB. When the exhaust air is conveyed out for example from the front edge of the mounting base, the further advantage is achieved that the outlet for exhaust air and the
inlet for cooling air are on different sides of the cabinet, and hence the hot exhaust air flow, i.e. blowing air, cannot circulate to the inlet for cold air, i.e. to the suction side. Since the exhaust air duct is in a separate mounting base, i.e. not in the same unit as the actual apparatus cabinet, this allows many different combinations of different mounting bases and different apparatus cabinets to be made. For example, several kinds of bases can be manufactured, and a base suitable for the particular application can be selected when the base station apparatus entity is assembled. Correspondingly, an apparatus cabinet suitable for each particular application can be selected for the base, since the apparatus cabinet and mounting base do not form a single unit.

The invention will be described in the following with reference to the accompanying drawings, in which

Figure 1 shows structural parts of a base station cabinet,

Figure 2 shows a second preferred embodiment of a mounting base for an apparatus cabinet in a top view.

Figure 1 shows a cooling arrangement entity S for cooling an apparatus cabinet 1 to be cooled and means 2 for conveying heated air out as an exhaust air flow B for cooling the apparatus cabinet. In a preferred embodiment, the apparatus cabinet 1 is an apparatus cabinet of a base station of a cellular radio network. In a preferred embodiment of the invention, said means 2 for conveying heated air out comprise a heat exchanger 2a with a divider element 2b and an interior air circulation duct 2d and an exterior air circulation duct 2e, said interior air circulation duct 2d and said exterior air circulation duct 2e being divided by the divider element 2c. The interior air circulation duct of the heat exchanger comprises an air inlet 2d(IN) and an air outlet 2d(OUT). The exterior air circulation duct 2e of the heat exchanger again comprises an air inlet 2e(IN) and an air outlet 2e(OUT). The heat exchanger 2a also incorporates guide means 3, i.e. a guide cover 3, directing the cold incoming air through opening 3a downwardly towards the inlet 2e(IN) of the exterior air circulation duct 2e of the heat exchanger. Furthermore, the guide cover 3 directs the heated air emerging through the outlet 2e(OUT) of the exterior circulation duct 2e of the heat exchanger, from the upper portion of the heat exchanger, downwardly towards opening 3b in the bottom of the guide cover. Heating of the air in the exterior air circulation duct is a result of the fact that the warmer air in the interior air circulation duct on the other side of the divider
element 2a in the heat exchanger gives up heat to the other side of the divider
element 2b of the heat exchanger, i.e. to the exterior air circulation duct 2e.

In accordance with the invention, the means 2 for conveying heated
air out are in communication with an exhaust duct 4a in the separate mounting
base 4 beneath the apparatus cabinet for conveying heated air out through
said exhaust duct 4a. When a heat exchanger is involved, the solution is such
that the exhaust duct 4a in the separate mounting base 4 beneath the appar-
atus cabinet is in communication with the outlet 2e(OUT) of the exterior air
circulation duct of the heat exchanger.

At its simplest, the exhaust duct 4a is comprised by the interior of
the mounting base 4, but preferably for example a narrower duct 4a wherein
the exhaust air flow can be turned is provided therein.

In a preferred embodiment, the cooling arrangement is such that
the exhaust duct in the mounting base includes one or more turning points 5-6
at which the direction of the exhaust air flow is turned. In a preferred embodi-
ment, the cooling arrangement is such that the exhaust duct 4a in the
mounting base 4 comprises at least two turning points, i.e. turning points 5 and
6, and that the turning points 5 and 6 are directed so as to turn the exhaust air
flow in different directions. In Figure 1, turning point 5 is adapted to turn the
exhaust air flow clockwise and turning point 6 is adapted to turn the exhaust
air flow counter-clockwise. Said preferred embodiments abate the noise of the
exhaust air flow to a still lower level.

In a preferred embodiment of the invention, the solution is such that
opening 4b at the end of the exhaust duct is on a different side, i.e. preferably
on the opposite side, from the inlet 3a for cooling air comprised by the cooling
arrangement. The opening 4b at the end of the exhaust duct 4a is preferably
on the front side of the apparatus cabinet. In a preferred embodiment, the
exhaust opening 4a of the base 4 is thus in the lower portion of the cooling
arrangement, whereas the inlet 3a for cooling air comprised by the cooling
arrangement is in the upper portion of the cooling arrangement. In that situa-
tion, the cooling air is thus introduced into the upper portion of the cooling
arrangement and the exhaust air flow B is discharged from the lower portion of
the cooling arrangement. On account of these preferred embodiments, the hot
exhaust air flow, i.e. blowing air, cannot circulate to the inlet for cold air to
opening 3a, i.e. to the suction side.
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Seen as a cooling method, a method is involved for cooling an apparatus cabinet 1, in which method air A is taken in into a cooling arrangement 2 provided in connection with the apparatus cabinet 1, and heated air is discharged from the cooling arrangement as an exhaust air flow B. In accordance with the invention, the exhaust air flow B is conveyed out through the mounting base 4, 4a of the apparatus cabinet. In a preferred embodiment of the invention, the method is such that the direction of the exhaust air flow B is turned in the exhaust duct 4a in the mounting base 4 and at its turning points 5-6. The exhaust air flow B is preferably turned in at least two different directions in the mounting base 4.

In a preferred embodiment of the method, the exhaust air flow B is conveyed out on a different side of the apparatus cabinet, i.e. preferably on the opposite side, through opening 4b, from the side to which the cooling air A is brought. The cold cooling air A is thus brought to the rear, up into opening 3a and it exits as a warm exhaust air flow B from the front, down through opening 4a after having passed through the exterior circulation duct 2e of the heat exchanger and through the exhaust duct 4a in the mounting base.

In a preferred embodiment of the invention, the cooling arrangement comprises an interconnecting piece 7, and in such a case the exhaust air flow B is conveyed with the interconnecting piece 7 to the mounting base 4. In a preferred embodiment, the direction of the exhaust air flow is changed already in the interconnecting piece 7. In the example of Figure 1, the exhaust air flow B is turned from vertical to horizontal and thus at the same time shifts the exhaust air flow to the mounting base 4, to the exhaust duct 4a thereof.

A heat exchanger 2a-e, 3 is preferably employed in the cooling method on account of its simplicity and efficiency. In such a case, the exhaust air flow B is conveyed to the mounting base 4 from the outlet 2e(IN) of the exterior air circulation duct 2e of the heat exchanger, preferably from the lower portion of the heat exchanger.

In another embodiment, no heat exchanger is used but in such a case the means 2 for conveying heated air out comprise an air-conditioning unit including a fan (not shown). In that case, the exhaust duct in the mounting base of the apparatus cabinet is in communication with the outlet in the air-conditioning unit.

Figure 2 shows a second preferred embodiment of a mounting base for an apparatus cabinet, shown from the inside. In Figure 2, the mounting
base is denoted by reference numeral 40. In a preferred embodiment of the invention, the mounting base includes an absorbent material 50 improving the efficiency of noise reduction and shaping the flow. Absorbent material 50 is provided preferably in the form of elongated bars having the direction of the flow and as also on the bottom of the mounting base. In a preferred embodiment, the solution is such that the absorbent material 50 within the mounting base 40 and/or the side, bottom or top walls 60 of the mounting base 50 define one or more exhaust ducts 40a for the exhaust air flow B in the mounting base 40. With such a solution, in the Applicant's observation the desired abatement is achieved with a simple construction without the flow being prevented too much. In Figure 2, the exhaust air flow B is brought to the mounting base through one or more openings 40c and exits through one or more openings 40b.

Even though the invention has been described above with reference to examples in accordance with the accompanying drawings, it is obvious that the invention is not restricted thereto, but it can be modified in many ways within the scope of the inventive idea set forth in the appended claims.
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Claims:

1. A cooling arrangement for cooling an apparatus cabinet, comprising an apparatus cabinet (1) to be cooled and means (2) for conveying heated air out as an exhaust air flow (B) for cooling the apparatus cabinet, characterized in that to reduce the noise of the exhaust air flow, the means (2) for conveying heated air out are in communication with a separate mounting base (4) beneath the apparatus cabinet (1), comprised by the cooling arrangement, for conveying heated air (B) out through an exhaust duct (4a) in said separate mounting base (4) beneath the apparatus cabinet.

2. A cooling arrangement as claimed in Claim 1, characterized in that in the mounting base the exhaust air duct (4a) comprises one or more turning points (5, 6) at which the direction of the exhaust air flow (B) is turned.

3. A cooling arrangement as claimed in Claim 2, characterized in that in the mounting base the exhaust air duct (4) comprises at least two turning points (5, 6) and that the turning points (5, 6) are directed so as to turn the exhaust air flow (B) in different directions.

4. A cooling arrangement as claimed in Claim 1, characterized in that at the end of the exhaust duct (4a) in the mounting base, one or more exhaust openings (4b) are provided that are on a different side of the cooling arrangement from the inlet (3a) for cooling air comprised by the cooling arrangement.

5. A cooling arrangement as claimed in Claim 4, characterized in that the exhaust opening (4b) at the end of the exhaust duct (4a) in the mounting base is on the opposite side of the cooling arrangement from the inlet (3a) for cooling air comprised by the cooling arrangement.

6. A cooling arrangement as claimed in Claim 1, characterized in that one or more exhaust openings (4b) are provided at the end of the exhaust duct (4a) in the mounting base, the exhaust openings being in the lower portion of the cooling arrangement, whereas the inlet (3a) for cooling air comprised by the cooling arrangement is in the upper portion of the cooling arrangement.

7. A cooling arrangement as claimed in Claim 1, characterized in that the opening (4b) at the end of the exhaust duct (4a) in the
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separate mounting base (4) beneath the apparatus cabinet is at the front of the apparatus cabinet.

8. A cooling arrangement as claimed in Claim 1, characterized in that the arrangement comprises an interconnecting piece (7), and that the means (2) for conveying heated air (B) out are in communication through said interconnecting piece (7) with the exhaust air duct (4a) comprised by the separate mounting base (4) of the cooling arrangement beneath the apparatus cabinet (1).

9. A cooling arrangement as claimed in Claim 1, characterized in that the means (2) for conveying heated air out comprise a heat exchanger (2a, 3) with a divider element (2b) and an interior air circulation duct (2d) and an exterior air circulation duct (2e) divided by the divider element (2b), the interior air circulation duct (2d) comprising an air inlet (2d(IN)) and an air outlet (2d(OUT)) and the exterior air circulation duct (2e) comprising an air inlet (2e(IN)) and an air outlet (2e(OUT)), and that the exhaust duct (4a) in the mounting base (4) of the apparatus cabinet (1) is in communication with the outlet (2e(OUT)) of the exterior air circulation duct (2e) of the heat exchanger (2a, 3).

10. A cooling arrangement as claimed in Claim 1, characterized in that the means (2) for conveying heated air out comprise an air-conditioning unit including a fan, and that the exhaust duct (4a) in the mounting base (4) of the apparatus cabinet is in communication with the outlet in the air-conditioning unit.

11. A cooling arrangement as claimed in Claim 1, characterized in that the apparatus cabinet (1) is an apparatus cabinet (1) of a base station of a cellular radio network or other radio network.

12. A cooling arrangement as claimed in Claim 1, characterized in that the exhaust duct (4a) in the separate mounting base (4) beneath the apparatus cabinet includes an absorbent material (50).

13. A cooling arrangement as claimed in Claim 1 or Claim 12, characterized in that the absorbent material within the separate mounting base beneath the apparatus cabinet and/or the walls of the mounting base define an exhaust duct (40a) in the mounting base (40) for the exhaust air flow.

14. A method for cooling an apparatus cabinet, in which method air (A) is taken in into a cooling arrangement provided in connection with the
apparatus cabinet (1) and heated air is conveyed out from the cooling arrangement as an exhaust air flow (B), characterized in that the exhaust air flow (B) is conveyed out through a separate mounting base (4) beneath the apparatus cabinet (1).

15. A method as claimed in Claim 14, characterized in that the exhaust air flow (B) is conveyed out through an exhaust duct (4a) in the separate mounting base (4) beneath the apparatus cabinet (1).

16. A method as claimed in Claim 14, characterized in that the direction of the exhaust air flow (B) is turned in an exhaust duct (4a) in the mounting base (B) at one or more turning points (5, 6).

17. A method as claimed in Claim 14, characterized in that the exhaust air flow (B) is turned in at least two different directions.

18. A method as claimed in Claim 14, characterized in that the exhaust air flow (B) is conveyed out on a different side from the inlet side for the cooling air (A).

19. A method as claimed in Claim 14, characterized in that the exhaust air flow (B) is conveyed out on the opposite side from the inlet side for the cooling air (A).

20. A method as claimed in Claim 14, characterized in that the cooling air is introduced into the upper portion of the cooling arrangement and the exhaust air flow (B) is discharged from the lower portion of the cooling arrangement.

21. A method as claimed in Claim 14, characterized in that the exhaust air flow (B) is conveyed by means of an interconnecting piece (7) to the mounting base (4).

22. A method as claimed in Claim 21, characterized in that the direction of the exhaust air flow (B) is changed in the interconnecting piece (7).

23. A method as claimed in Claim 14, wherein a heat exchanger (2a-2e, 3) with a divider element (2b) and an interior air circulation duct (2d) and an exterior air circulation duct (2e) divided by the divider element (2b) is employed in a manner known per se, the interior air circulation duct (2d) comprising an air inlet (2d(IN)) and an air outlet (2d(OUT)) and the exterior air circulation duct (2e) comprising an air inlet (2e(IN)) and an air outlet (2e(OUT)), characterized in that the exhaust air flow (B) is conveyed to the mounting base (4) from the outlet (2e(OUT)) of the exterior air circulation
duct (2e) of the heat exchanger (2a-2e, 3), preferably from the lower portion of the heat exchanger.
A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H05K 7/20, H04B 1/036

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H05K, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C.  
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Date of the actual completion of the international search

15 April 1997

Date of mailing of the international search report

17-04-1997

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### International Search Report

**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

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