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(54) **WIND POWER PLANT**

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(57) **ABSTRACT**

The present invention concerns a wind power installation comprising a pod having at least one fluid-cooled component and a heat exchanger. To simplify transport and construction of a wind power installation with a heat exchanger and thus to eliminate or at least reduce sources of error in the wind power installation of the kind set forth in the opening part of this specification the heat exchanger is integrated into the external contour of the pod. In that respect the present invention is based on the realization that in that way when transporting and handling the pod, there is no need for any alterations worth mentioning, at the same time however the heat exchanger can also be installed upon assembly of the pod in the factory and can be tested for satisfactory functioning. That leads to a simplification in transporting and constructing the wind power installation and at the same time eliminates possible error sources.

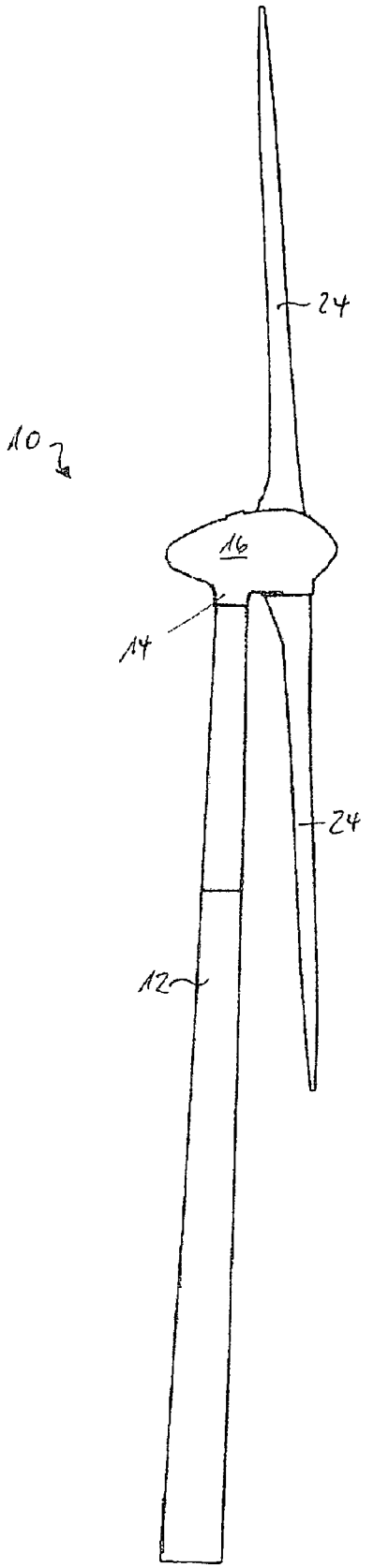


Fig. 1

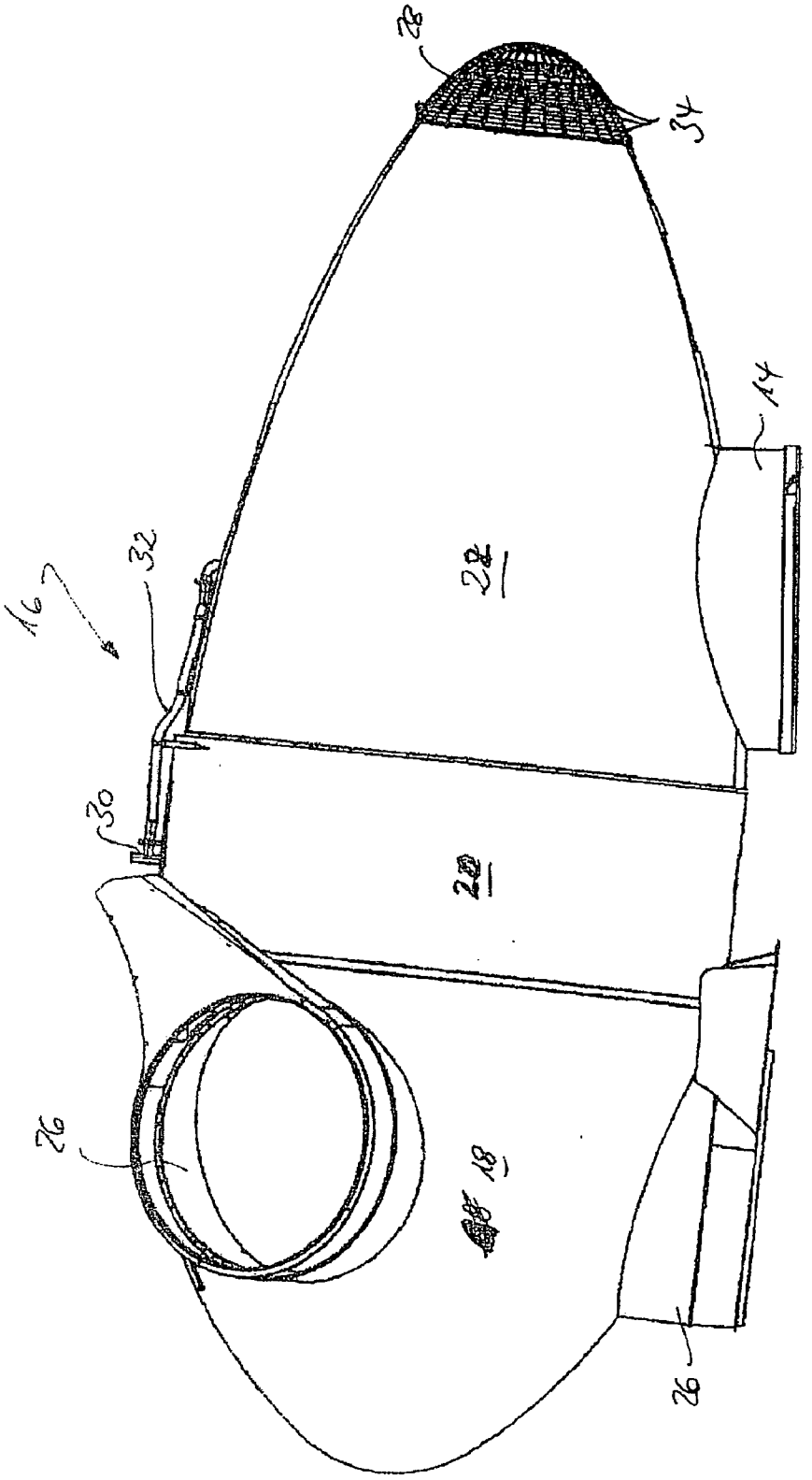


Fig. 2

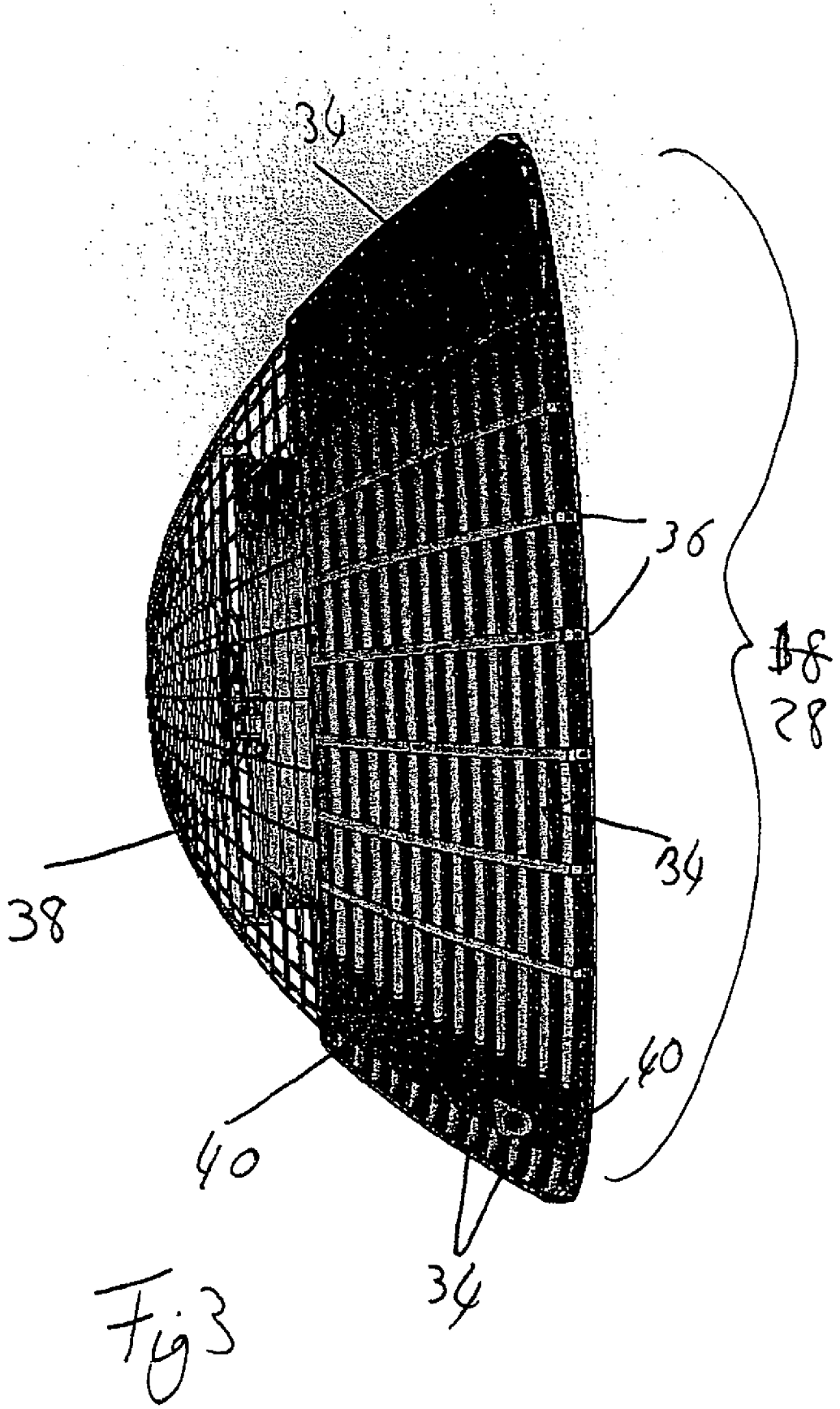


Fig 3

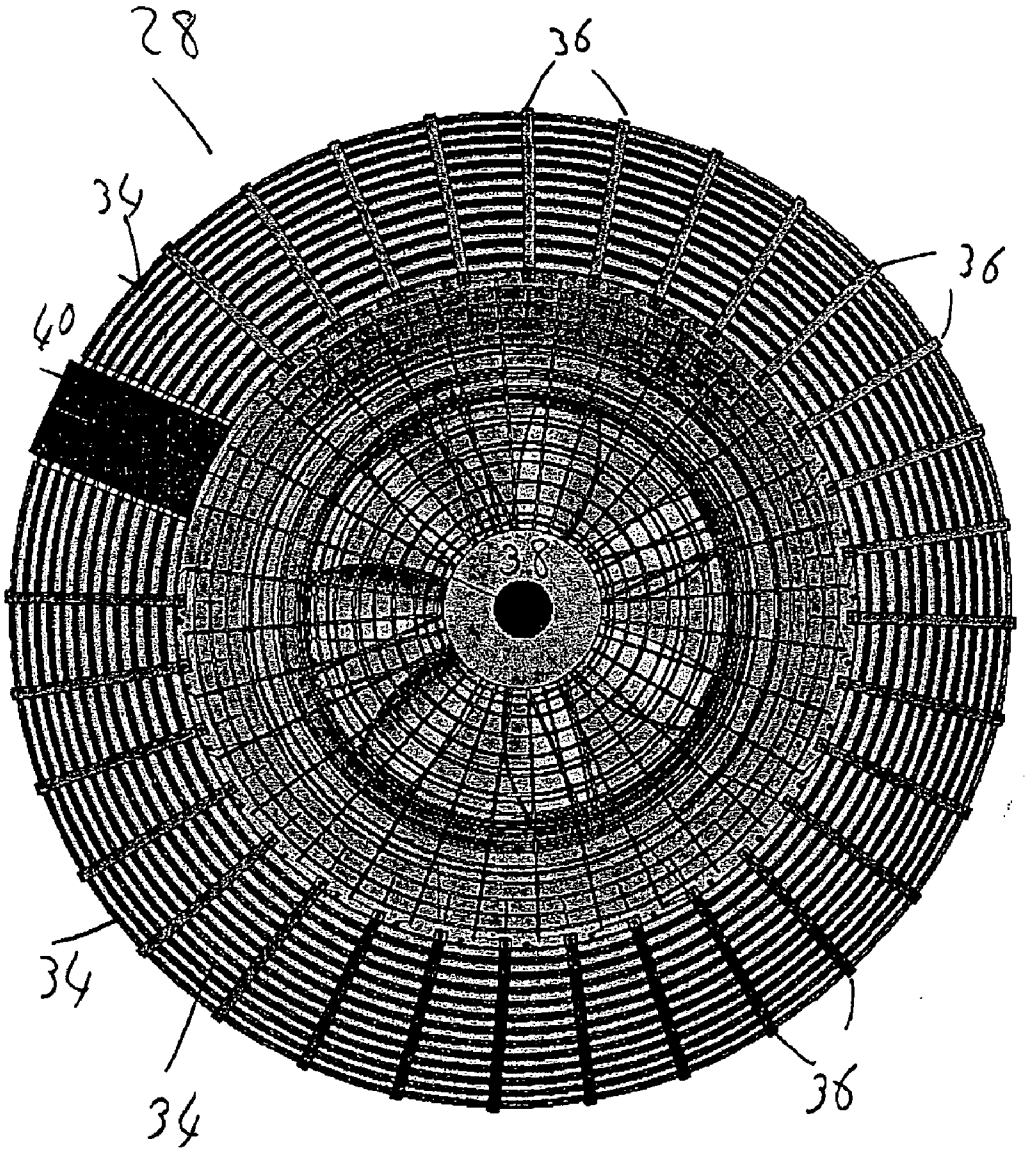


Fig 4

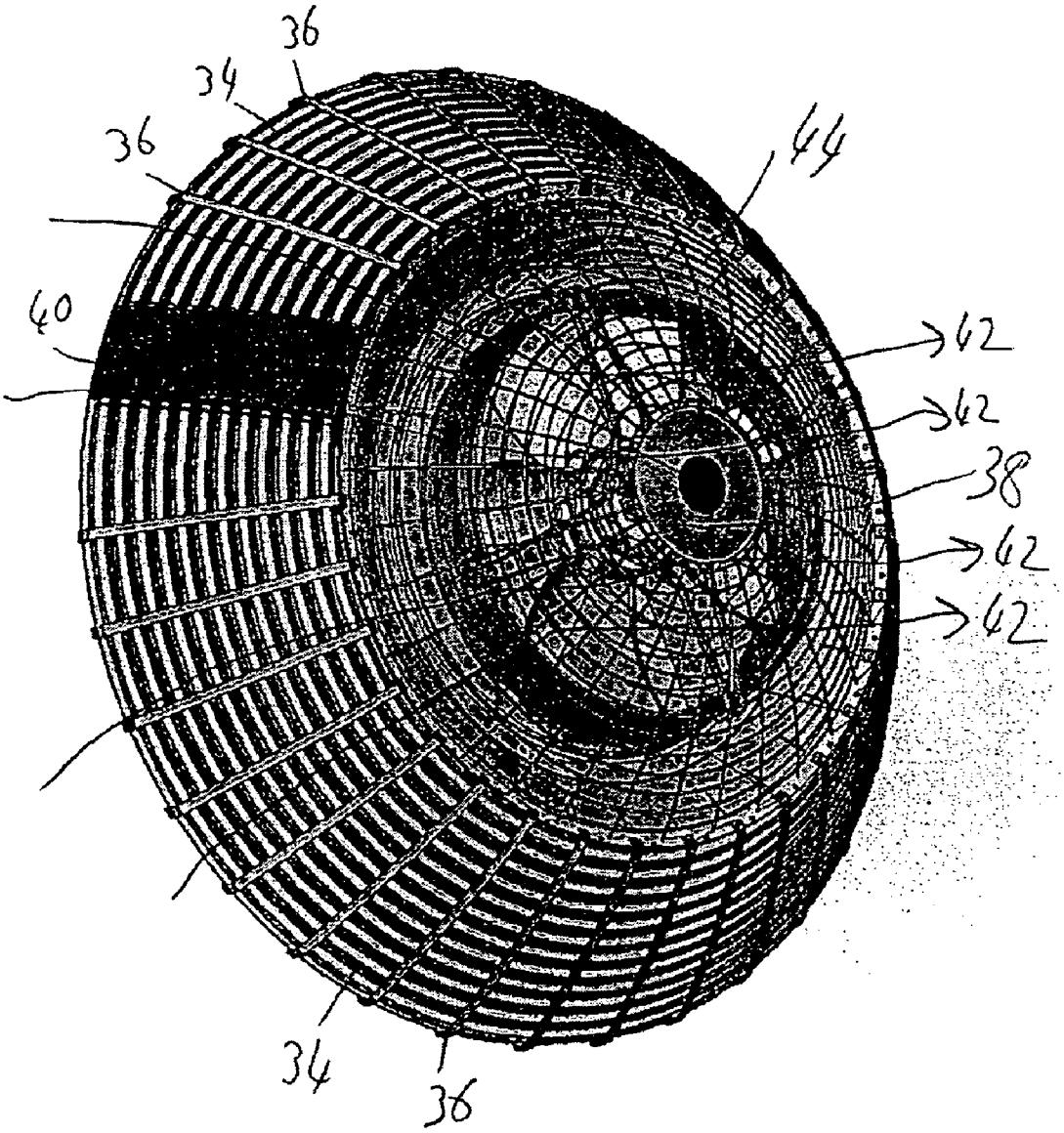


Fig 5

WIND POWER PLANT

BACKGROUND

[0001] 1. Technical Field

[0002] The present invention concerns a wind power installation comprising a pod with at least one fluid-cooled component and a heat exchanger. Such wind power installations are known in large numbers in the state of the art.

[0003] 2. Description of the Related Art

[0004] Wind power installations with different pod shapes are also known. In that respect substantially rectangular or box-shaped pods, sometimes called gondolas are represented as well as cylindrical pods and pods approximating to a drop shape.

[0005] As a heat exchanger must be able to give off the heat to be dissipated to the environment in order to be able to perform its function, it is usual to arrange it on the top side of the pod in wind power installations. That is effected for example when erecting a wind power installation on the building site so that the heat exchanger arranged on the pod does not cause difficulties in transporting and handling the pod or so that it cannot be damaged in that case. Therefore the heat exchanger is usually fitted in place during erection of the wind power installation on the building site. In that case however a wide range of different mounting errors can occur, which adversely affect satisfactory functioning of the heat exchanger.

BRIEF SUMMARY

[0006] Therefore the object of the present invention is to simplify transport and construction of a wind power installation having a heat exchanger and thus to eliminate or at least reduce sources of error.

[0007] In a wind power installation of the kind set forth in the opening part of this specification, that is achieved in accordance with the invention by integrating the heat exchanger into the external contour of the pod.

[0008] The object of the invention is attained by a wind power installation as set forth in claim **1**.

[0009] Accordingly there is provided a wind power installation comprising a pod having at least one fluid-cooled component and a heat exchanger. In that case the heat exchanger is integrated into the external contour of the pod.

[0010] In an aspect of the invention the heat exchanger has at least one ribbed tube.

[0011] In a further aspect of the invention the heat exchanger is formed from a ribbed tube which at least partially is continuously wound.

[0012] In a further aspect of the invention the heat exchanger has a plurality of ribbed tubes arranged in parallel relationship.

[0013] In a further aspect of the invention the heat exchanger is arranged on a carrier.

[0014] In a further aspect of the invention the carrier is in the form of a peripherally extending opening in the contour of the pod.

[0015] In a further aspect of the invention the carrier is in the form of a separate pod component.

[0016] In a further aspect of the invention the wind power installation, in the direction of a longitudinal axis of the pod, has a hold-down means which holds the ribbed tube in its installation position.

[0017] In a further aspect of the invention the wind power installation has a fan arranged in such a way that the air that it draws in flows around the heat exchanger.

[0018] In that respect the present invention is based on the realization that when transporting and handling the pod, there is no need for any alterations worth mentioning, at the same time however the heat exchanger can also be installed upon assembly of the pod in the factory and can be tested for satisfactory functioning. That leads to a simplification in transporting and constructing the wind power installation and at the same time eliminates possible error sources.

[0019] In a preferred embodiment the heat exchanger can be formed from at least one ribbed tube. Such a ribbed tube can be easily bent in such a way that it follows the contour of the pod and can therefore be well adapted to the pod contour.

[0020] A high level of reliability is afforded if the heat exchanger is formed from a continuously wound ribbed tube because then it is possible to eliminate connecting locations and thus possible error locations at which for example leaks can occur.

[0021] To provide an adequate cooling efficiency the heat exchanger can also be formed from a plurality of ribbed tubes arranged in parallel relationship, thus affording a larger available cross-section in which the cooling fluid can be cooled.

[0022] Particularly preferably the heat exchanger is arranged on a carrier. In that way that heat exchanger can be pre-produced in the form of a structural unit and mounted in the form of an attachment component to the pod. In that way functional testing can for example already be effected before it is attached to the pod so that a reliable heat exchanger is certain to be available when the pod is assembled.

[0023] In an alternative embodiment the carrier can be in the form of a peripherally extending opening in the contour of the pod. It is possible in that way to avoid sources of error when attaching the separately produced cooler, such as for example incorrect positioning, damage caused by failure to pay proper attention during transport, and so forth.

[0024] To hold the ribbed tube or tubes of the heat exchanger in an intended installation position, there can be hold-down means which are distributed over the periphery of the heat exchanger and arranged substantially in the direction of the longitudinal axis of the pod.

[0025] In a preferred development of the invention there is provided a fan so arranged that the air drawn in thereby flows around the heat exchanger. That provides an active heat exchanger and a defined level of cooling efficiency for the heat exchanger.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0026] An advantageous embodiment is illustrated in the Figures in which:

[0027] FIG. **1** shows a simplified view of a wind power installation,

[0028] FIG. **2** shows a view on an enlarged scale of the pod of the wind power installation of FIG. **1**,

[0029] FIG. **3** shows a side view of a heat exchanger according to the invention in the form of an attachment component,

[0030] FIG. **4** shows a plan view of a heat exchanger according to the invention, and

[0031] FIG. **5** shows a perspective view of the heat exchanger with the flow configuration of the cooling air sucked in by the fan.

DETAILED DESCRIPTION

[0032] FIG. **1** shows a greatly simplified view of a wind power installation **10**. The pylon **12** carries the pod **16** (alternatively the term machine housing or gondola can also be used for the pod). The pod **16** is mounted on a head of the pylon **12** by means of an azimuth bearing (not shown) so that it is possible to provide wind direction tracking by way of azimuth drives (also not shown). The transition between the pod **16** and the pylon **12** is covered by a pod skirt **14** and is thus protected from the influences of weather.

[0033] The pod **16** also includes the hub to which the rotor blades **24** are mounted. The hub (with the front part of the pod **16**) is caused to rotate by the rotor blades **24**. The rotary movement is transmitted to the rotor of the generator so that the wind power installation **10** generates electrical energy when there is a sufficient wind speed.

[0034] FIG. **2** shows a more detailed view of the pod **16** of the wind power installation of FIG. **1**. The pod has a pod skirt **14** which covers over the transition from the pod **16** to the pylon (not shown in this Figure). The pod **16** has a front pod part **18** and a rear pod part **22**. The generator **20** can be disposed between those two pod parts. The generator **20** can optionally be in the form of a ring generator.

[0035] Rotor blade domes **26** with blade enlargement portions can be provided on the front pod part **18**. The respective rotor blade roots of the rotor blades (not shown in this Figure) can be guided into those rotor blade domes **26** and fastened to the rotor hub which transmits the rotary movement by way of a transmission or also directly, without a transmission, to the rotor as the rotary part of the generator **20** (not shown in this Figure).

[0036] The electrical energy generated when there is a sufficient wind speed is generated in the generator **20** and depending on the respective concept of the wind power installation can be fed by way of a transformer (not shown) for example directly into the network or can be converted into a direct current by way of rectifiers (also not shown) and then fed into the network again by way of inverters at a suitable frequency and phase position. A part of those described components can be disposed in the pod **16**. At any event however in dependence on the power generated in the generator **20**, heat due to energy losses is produced, which has to be dissipated by cooling. That cooling can involve air cooling; it can however also use a cooling fluid such as for example water. It is precisely when a high thermal loading is involved that air cooling may be inadequate and fluid cooling can be required. Accordingly the generator **20** can have a generator cooling connection **30** from which a connection **32** is taken to the heat exchanger **28** at one side of the pod (at the right in the Figure). The cooling fluid flows through the generator cooling connection **30**, the connection **32** and through the heat exchanger **28**. The heat exchanger **28** is once again exposed to the flow of air and is of a sufficiently large surface area to reliably implement the required dissipation of heat so that the correspondingly cooled cooling fluid can again be fed to the generator in order to continue to reliably dissipate the heat due to energy losses.

[0037] The heat exchanger **28** which in the present example is formed from ribbed tubes **34** is fitted into or on to the contour of the pod **16** so that the aerodynamically favorable shape of the pod **16** is not detrimentally altered by the heat exchanger **28**. In other words the heat exchanger thus replaces a part of the pod and is matched to the shape thereof so that the original shape of the pod is maintained to achieve an as aerodynamic shape as possible. In this case the heat exchanger can be provided at the end of the pod, opposite to the rotor **18**, and can be of a dome-shaped configuration. Alternatively or additionally the heat exchanger can be at least partially oval or elliptical in cross-section. Alternatively the heat exchanger can be of a cap-shaped configuration. That provides for adequate cooling of the cooling fluid utilizing the advantageous shape of the pod **16**. The heat exchanger can also be of an elliptical external contour.

[0038] FIG. **3** shows a heat exchanger **28** according to the invention in the form of a separate attachment component. That heat exchanger according to the invention has ribbed tubes **34** which are wound on to a carrier in such a way that the external contour is a continuation of the pod contour, that is substantially true to the shape thereof, that is to say the contour of the heat exchanger is oval (in cross-section), dome-shaped or cap-shaped. So that the ribbed tubes **34** remain in position there are provided hold-down means **36** which hold the ribbed tubes **34** in the predetermined position. A fan **38** can be arranged downstream of the ribbed tubes **34** in the flow direction, the fan **38** drawing in air in such a way that it flows over the ribbed tubes **34** and thus the excess heat can be dissipated.

[0039] While FIG. **3** shows a side view of an embodiment by way of example of a heat exchanger according to the invention and FIG. **4** shows a rear view, that is to say a view on to the heat exchanger **28**, as is represented from the rear side of the pod. It will be noted in this respect however that, as in FIG. **3**, the pod is not shown. It is possible to clearly see in FIG. **4** the ribbed tubes **34**, the hold-down means **36** and the fan **38**. FIG. **4** also clearly shows a connecting box **40** to which all ribbed tubes **34** are connected. Through that connecting box **40** the cooling fluid can flow simultaneously through all ribbed tubes **34** so as to provide a sufficiently large flow cross-section to dissipate the required amount of heat to the ambient air by way of the heat exchanger **28**. For that purpose the connecting box **40** is connected by way of a connection (not shown here) to the components to be cooled in the pod of the wind power installation.

[0040] A somewhat modified embodiment of the heat exchanger **28** according to the invention is shown in FIG. **5**. FIG. **5** shows a perspective view, once again without the pod of the wind power installation. As already described above, the ribbed tubes **34** extend from the connecting box **40** so that the cooling fluid can simultaneously flow through them to be able to provide the required cooling efficiency. The fan **38** is again arranged at the end of the heat exchanger **28** and is provided with a cover **44** which allows the air flow **42** to be better guided.

[0041] When the fan **38** is set in operation it produces a flow of the ambient air over the surface of the ribbed tubes **34** in the direction indicated by arrows **42** so that active cooling can be implemented with that heat exchanger **28** according to the invention to dissipate the waste heat to the ambient air.

[0042] As the heat exchanger according to the invention is fitted into the external pod contour the external appearance of the wind power installation is at most slightly influenced, but is substantially retained. Accordingly the flow conditions at the pod are also substantially retained and at the same time an adequate cooling effect on the part of the heat exchanger **28** is achieved.

[0043] For example, if the pod is shaped like a box, with the rear end having a rectangular shape, the heat exchanger would be rectangular in shape and will match the shape and cross-

section of the pod at the rear end. Thus, in the situation of the square or rectangular cross-section at the end, the tubes **34** will be in a shape that bends, at some places, and may have corners, as one example. The goal is to have a matching shape to that of the rear of the pod where they are coupled so that the heat exchanger can easily be added at the end of the pod either at the factory where the pod is built or later if desired. Even though it has some shape as the rear of the pod where it coupled, it can narrow down to change shape of the length of the heat exchanger as it extends backward.

[0044] The various embodiments described above can be combined to provide further embodiments. All of the U.S. patents, U.S. patent application publications, U.S. patent application, foreign patents, foreign patent application and non-patent publications referred to in this specification and/or listed in the Application Data Sheet are incorporated herein by reference, in their entirety. Aspects of the embodiments can be modified, if necessary to employ concepts of the various patents, application and publications to provide yet further embodiments.

[0045] These and other changes can be made to the embodiments in light of the above-detailed description. In general, in the following claims, the terms used should not be construed to limit the claims to the specific embodiments disclosed in the specification and the claims, but should be construed to include all possible embodiments along with the full scope of equivalents to which such claims are entitled. Accordingly, the claims are not limited by the disclosure.

1. A wind power installation comprising:
a pod with at least one fluid-cooled component and a heat exchanger,
wherein the heat exchanger is integrated into the external contour of the pod.

2. A wind power installation according to claim **1** wherein the heat exchanger has at least one ribbed tube.

3. A wind power installation according to claim **1** wherein the heat exchanger has a ribbed tube which is at least partially continuously wound.

4. A wind power installation according to claim **1** wherein the heat exchanger has a plurality of ribbed tubes arranged in parallel relationship.

5. A wind power installation according to claim **1** wherein the heat exchanger is arranged on a carrier.

6. A wind power installation according to claim **5** wherein the carrier is in the form of a peripherally extending opening in the contour of the pod.

7. A wind power installation according to claim **5** wherein the carrier is in the form of a separate pod attachment component.

8. A wind power installation according to claim **2** and further comprising hold-down means which are arranged in the direction of a longitudinal axis of the pod and which hold the ribbed tube or tubes in the installation position thereof.

9. A wind power installation according to claim **1** and further comprising a fan so arranged that the air drawn in thereby flows around the heat exchanger.

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