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(54) COOLING TOWER

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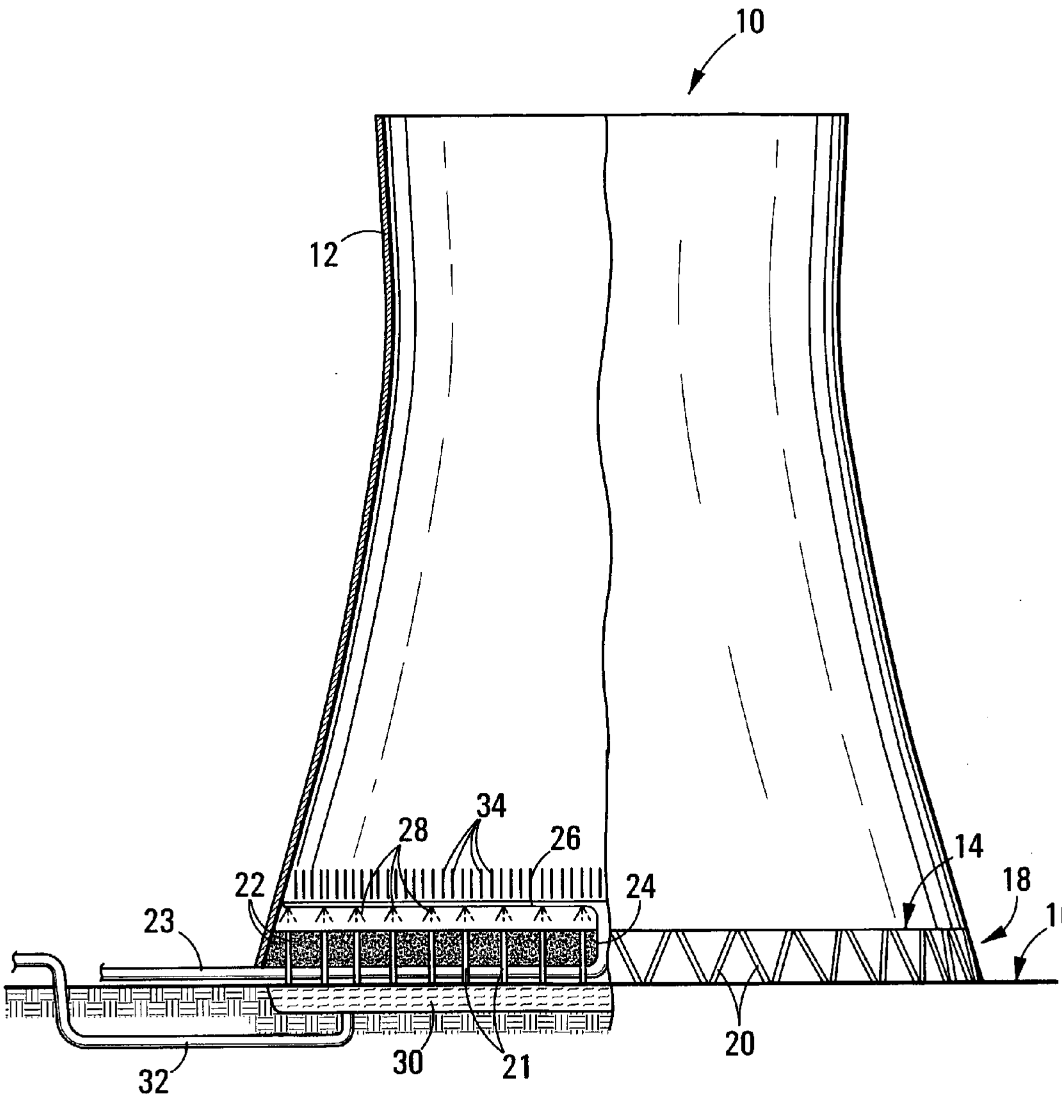
(57) ABSTRACT

A method of operating an evaporative cooling tower includes contacting water with air in a cooling zone to cool the water and heat the air and cooling the heated air to condense water therefrom, thereby to reduce water loss from the cooling tower. Typically, the cooling of the heated air is by means of evaporative cooling employing a refrigerant.



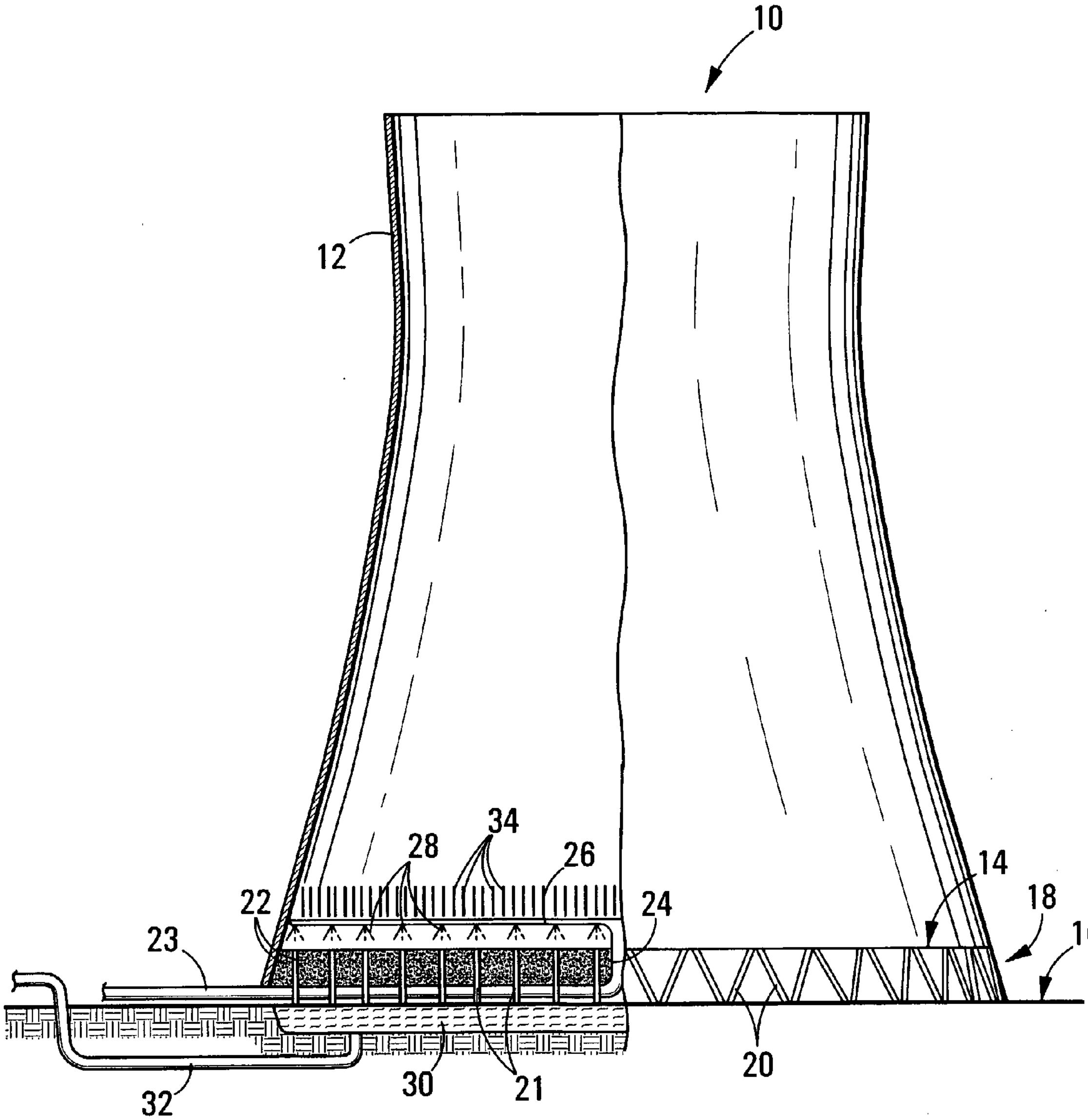


FIG 1

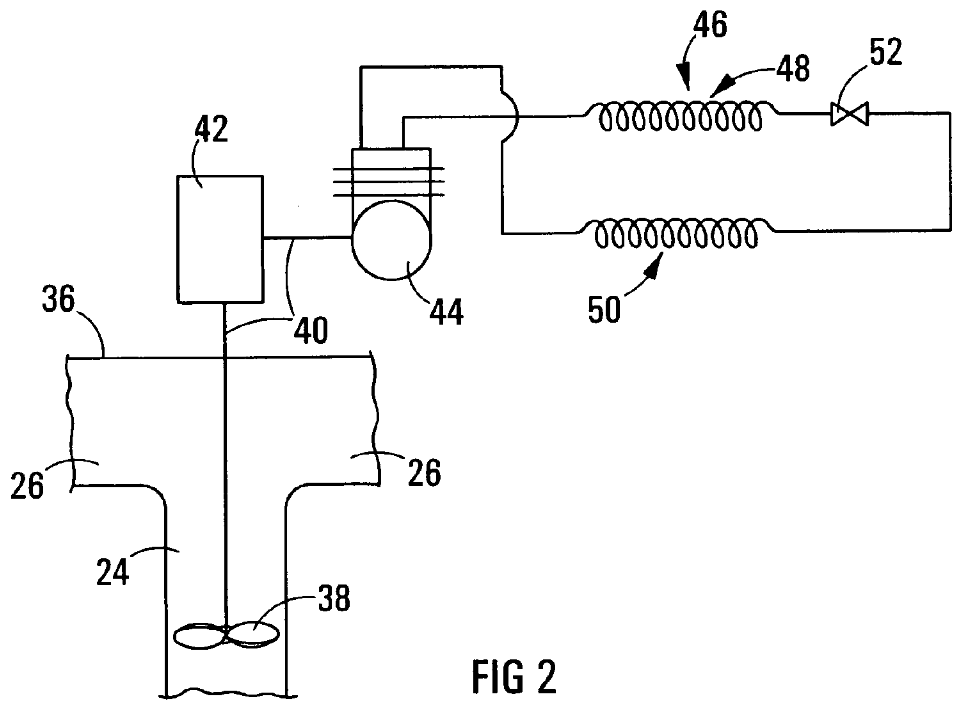


FIG 2

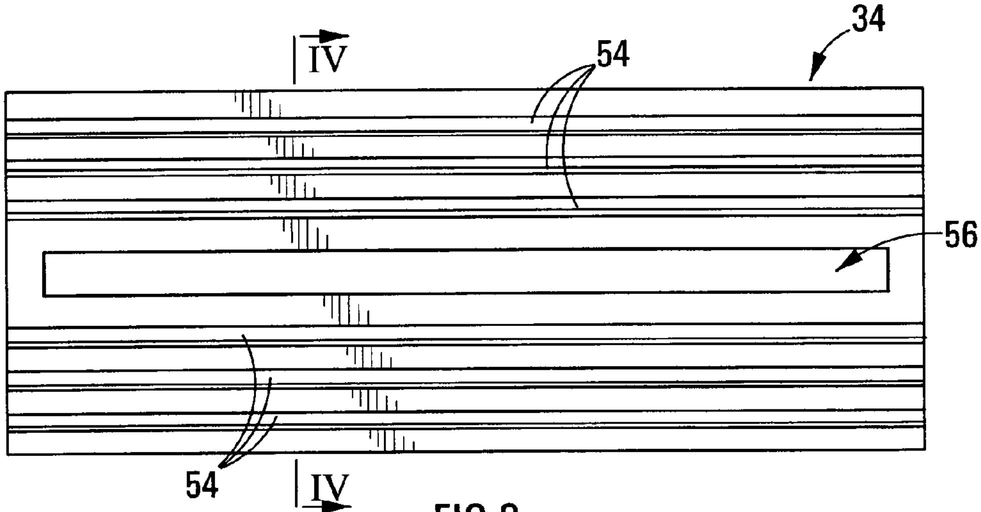


FIG 3

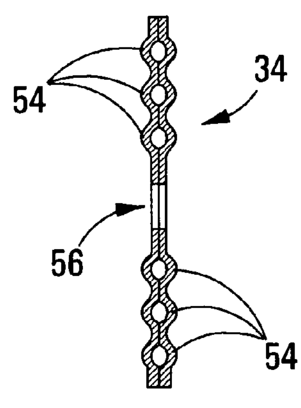


FIG 4

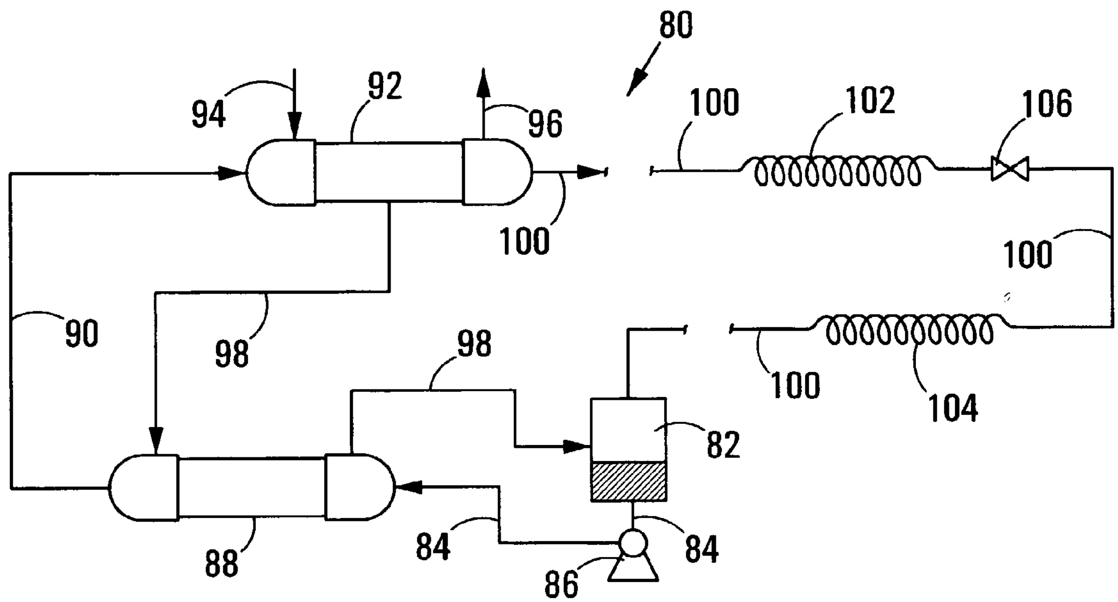


FIG 5

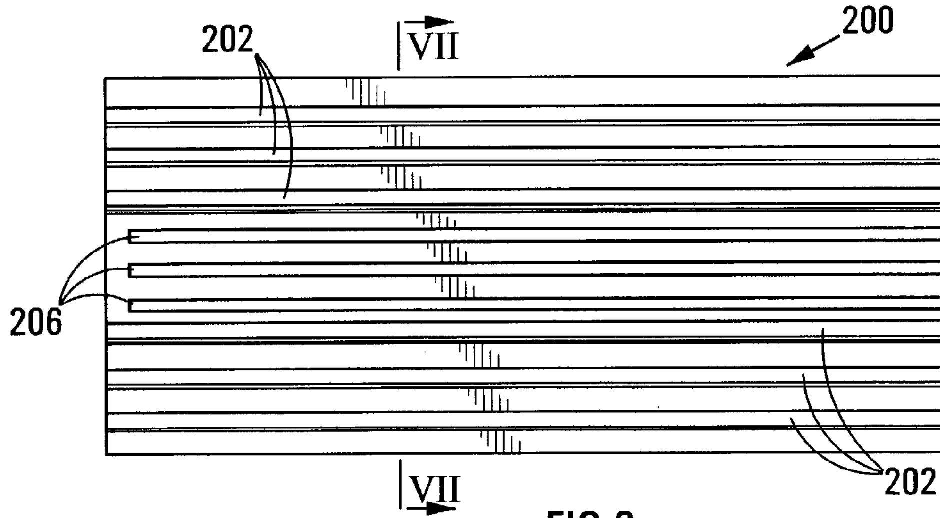


FIG 6

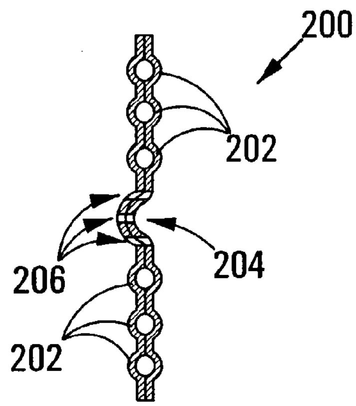


FIG 7

COOLING TOWER

[0001] THIS INVENTION relates to a cooling tower. In particular, it relates to a method of operating a cooling tower, and to a cooling tower operable in accordance with the method.

[0002] In accordance with a first aspect of the invention, there is provided a method of operating an evaporative cooling tower which includes

[0003] contacting water with air in a cooling zone to cool the water and heat the air; and

[0004] cooling the heated air to condense water therefrom, thereby to reduce water loss from the cooling tower.

[0005] The cooling of the heated air may be by means of evaporative cooling employing a refrigerant, such as Freon. The evaporative cooling of the heated air may be provided by a compression refrigeration system. Instead, the evaporative cooling of the heated air may be provided by an absorption refrigeration system.

[0006] The evaporative cooling tower may be a natural draught cooling tower with upwardly moving air and the cooling of the heated air is thus being effected at a particular elevation or level in the cooling tower. The method may include, above the level of the cooling of the heated air, heating the upwardly moving air to promote the draught in the cooling tower.

[0007] The refrigeration system may include a condenser and an evaporator, arranged in a circuit. The evaporator may be at a low elevation inside the cooling tower to cool the upwardly moving air and remove water therefrom by condensation, and the condenser may be located above the evaporator to heat the upwardly moving air, which is dried air, to promote the draught in the tower. There may be several such circuits, each with its own compressor, condenser, etc.

[0008] The cooling tower typically employs filling with drift eliminators, which may be plate-like, above the filling in the tower. The evaporator may comprise one or more coils in or on one or more drift eliminators and the condenser may comprise one or more coils in or on one or more drift eliminators located above the evaporator coil or coils.

[0009] In accordance with another aspect of the invention, there is provided, in a natural draught cooling tower of the type used for large scale water cooling as in the cooling of water used by thermal power stations, and which comprises a typically concrete hollow shell which is circular in plan view and has walls which are concave and parabolic in side view outline, the bottom of the tower being raised from ground level on stilts or the like to provide a circumferentially extending air inlet at its lower end and the tower containing filling at its lower end and a water distribution system for distributing water to be cooled onto the filling from which it drains into a reservoir under the tower while air circulates from the inlet up over the filling and out of the top of the tower by natural convection to cool the water, there is provided the method of operation which comprises, above the filling, cooling the upwardly moving air to condense water therefrom, thereby to reduce water loss from the tower at its top.

[0010] The method may include, above the level of cooling of the upwardly moving air, heating the upwardly moving air to promote the draught in the cooling tower.

[0011] The cooling of the upwardly moving air may be by evaporative cooling provided by a compression refrigeration system or an absorption refrigeration system. The refrigeration system typically includes a condenser and an evaporator arranged in a circuit. The evaporator may be located above the filling in the tower to cool the upwardly moving air and remove water therefrom by condensation, and the condenser may be located above the evaporator to heat the upwardly moving air, which is dried air, to promote the draught in the tower.

[0012] The cooling tower typically employs drift eliminators above the filling in the tower. The evaporator of the refrigeration circuit may comprise one or more coils in or on one or more drift eliminators, and the condenser of the refrigeration circuit may comprise one or more coils in or on one or more drift eliminators, located above the evaporator coil or coils.

[0013] According to a further aspect of the invention, there is provide an evaporative cooling tower which includes a cooling zone for contacting water with air to cool the water and heat the air, and a refrigeration or cooling system for cooling the heated air from the cooling zone for condensing water therefrom.

[0014] In one embodiment of the invention, the refrigeration system is a compression refrigeration system for the evaporative cooling of the air by means of a refrigerant. The compression refrigeration system may be arranged to heat the cooled air at a level above that at which the refrigeration system cools said air.

[0015] The compression refrigeration system typically comprises one or more cooling circuits, each comprising a condenser and an evaporator, in association with a refrigerant compressor and an expansion valve.

[0016] Each cooling circuit may thus include a compressor which is driven by a turbine and optionally via a gearbox. The gearbox, when present, will be between the turbine and the compressor. The turbine may be driven by an incoming stream of water to be cooled as it enters the cooling tower.

[0017] In another embodiment of the invention, the refrigeration system is an absorption refrigeration system for the evaporative cooling of the air by means of a refrigerant. The refrigerant is a gas soluble in a liquid solvent. The absorption refrigeration system may be arranged to heat the cooled air at a level above that at which the absorption refrigeration system cools said air.

[0018] The absorption refrigeration system typically comprises one or more cooling circuits, each comprising a generator, a condenser and an evaporator, in association with an expansion valve. Each circuit may have its generator located outside the cooling tower.

[0019] The cooling tower typically includes filling and drift eliminators. Each evaporator may comprise coils in or on one or more drift eliminators above the filling in the tower, and each condenser may comprise coils in or on one or more drift eliminators above the filling, the condenser coils being at a higher level than the evaporator coils.

[0020] In accordance with yet a further aspect of the invention, there is provided a natural draught cooling tower of the type used for large scale water cooling as in the cooling of water used by thermal power stations, and which comprises a typically concrete hollow shell which is circular in plan view and has walls which are concave and parabolic in side view outline, the bottom of the tower being raised from ground level on stilts or the like to provide a circumferentially extending air inlet at its lower end and the tower containing filling at its lower end and a water distribution system for distributing water to be cooled onto the filling from which it drains into a reservoir under the tower while air circulates from the inlet up over the filling and out of the top of the tower by natural convection to cool the water, the cooling tower further including a refrigeration system for cooling upwardly moving air in the tower above the filling, for condensing water therefrom.

[0021] In one embodiment of the invention, the refrigeration system is a compression refrigeration system for the evaporative cooling of the upwardly moving air by means of a refrigerant. The compression refrigeration system may be arranged to heat the cooled upwardly moving air at a level above that at which the compression refrigeration system cools said air.

[0022] The compression refrigeration system typically comprises one or more cooling circuits, each comprising a condenser and an evaporator, in association with a refrigerant compressor and an expansion valve. There may be several such cooling circuits.

[0023] Each cooling circuit may thus include a compressor which is driven by a turbine and optionally via a gearbox. The gearbox, when present, will be between the turbine and the compressor. The turbine may be driven by an incoming stream of water to be cooled as it enters the cooling tower.

[0024] In another embodiment of the invention, the refrigeration system is an absorption refrigeration system for the evaporative cooling of the air by means of a refrigerant, which will be a gas soluble in a liquid solvent. The absorption refrigeration system may also be arranged to heat the cooled upwardly moving air at a level above that at which the absorption refrigeration system cools said air.

[0025] The absorption refrigeration system typically comprises one or more cooling circuits, each comprising a generator, a condenser and an evaporator, in association with an expansion valve. There may be several such cooling circuits. Each circuit may have its generator located outside the cooling tower.

[0026] Cooling towers of the type in question typically employ plate-like drift eliminators above the filling in the tower. Each evaporator may comprise coils in or on one or more drift eliminators above the filling in the tower, and each condenser may comprise coils in or on one or more drift eliminators above the filling, the condenser coils being at a higher level than the evaporator coils.

[0027] The evaporator coils may be separated from the condenser coils by being on separate drift eliminators or by means of an air gap or insulating material if they are on the same drift eliminator, to avoid direct heat transfer therebetween, as the drift eliminators are preferably of heat-conductive material such as copper to promote cooling and heating respectively by the evaporator coils and the condenser coils.

[0028] The invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which

[0029] FIG. **1** shows a part-sectional side elevation of a cooling tower in accordance with the invention;

[0030] FIG. **2** shows diagrammatically a compression refrigeration circuit for the cooling tower of FIG. **1**;

[0031] FIG. **3** shows in side elevation a diagrammatic representation of a drift eliminator for the cooling tower of FIG. **1**, and forming part of the circuit of FIG. **2**;

[0032] FIG. **4** shows a sectional end elevation in the direction of line IV-IV in FIG. **3**, of the drift eliminator of FIG. **3**;

[0033] FIG. **5** shows diagrammatically an absorption refrigeration circuit for another embodiment of the invention;

[0034] FIG. **6** shows in side elevation a diagrammatic representation of another embodiment of a drift eliminator; and

[0035] FIG. **7** shows a sectional end elevation in the direction of line VII-VII in FIG. **6**, of the drift eliminator of FIG. **6**.

[0036] In FIG. **1** of the drawings, reference numeral **10** generally designates a cooling tower in accordance with the invention. The cooling tower **10** is a natural draught cooling tower of the type used for large scale water cooling as at a thermal power station. The cooling tower **10** comprises a hollow concrete shell **12** which is circular in plan view and in side elevation has walls with a profile which is concave and parabolic. The bottom **14** of the shell **12** is raised from the ground **16** to provide a circumferentially extending air inlet **18**. The shell **12** is supported on stilts **20**. The lower end of the tower, up to about the height of the inlet **18**, is packed with filling **22** made e.g. of wood, asbestos, or the like. The filling is permeable to air flow and water flow and provides a packing material over which water can flow downwardly in use of the cooling tower **10**, to provide a large air/water surface area for evaporative cooling. The filling **22** is supported on upright supports **21** which also act to support the water distribution system, drift eliminators, etc., described hereunder.

[0037] The cooling tower has a main hot water inlet pipe **23**, which extends e.g. from a power station, radially inwardly at ground level into the bottom of the tower **10**, to a central position where it has a riser **24**. From the top of the riser **24** a water distribution system extends, shown diagrammatically in FIG. **1** by a plurality of radially extending pipes **26** connected to a plurality of sprays **28**. The radial pipes **26** have a plurality of branch pipes (not shown), and the radial pipes and branch pipes are provided with the sprays **28**, so that, at the level of the top of the filling **22**, there is a multiplicity of downwardly directed, evenly distributed sprays **28**, for spraying water from the pipe **23** to be cooled, downwardly onto the filling **22**. Under the tower **10** is provided a reservoir **30** which empties into a cooled water outlet pipe **32** for returning cooled water to the power station (typically via pumps which are not shown). Above the level of the pipes **26** and the sprays **28** is provided a plurality of drift eliminators **34**. These drift eliminators provide a multiplicity of elongated flattened plates, spaced from one another in parallel arrays, the longitudinal direction of each drift eliminator extending substantially horizontally, with the plane of each drift eliminator extending substantially vertically. Thus, if each drift eliminator **34** is regarded as an elongated rectangular flat metal plate, its long edges will be horizontal and its short edges will be vertical.

[0038] In FIG. **2**, the riser **24** is shown. At the upper end of the riser **24** there is a manifold **36** feeding into the radial pipes **26**. A turbine **38** is shown in the riser **24**, having an output shaft **40** extending via a gearbox **42** to a compressor **44**. The compressor **44** forms part of a compression refrigeration circuit **46** employing Freon as a refrigerant. The circuit **46** includes a condenser **48**, an evaporator **50** and an expansion valve **52**, the condenser **48** being- connected between the expansion valve **52** and the outlet of the compressor **44**, and the evaporator **50** in turn being connected between the expansion valve **52** and the inlet to the compressor **44**.

[0039] With reference to FIGS. **3** and **4**, a drift eliminator is designated **34**. The drift eliminator **34** comprises a pair of copper sheets attached together face-to-face, and shaped so that the drift eliminator **34** has two sets of tubes **54** extending along opposite longitudinal edges thereof, the drift eliminator **34** being elongate rectangular in outline. In use, the drift eliminator **34** will be arranged so that its longer edges extend horizontally, as mentioned above, and as shown in FIGS. **3** and **4**, so that the upper set of tubes **54** forms part of the evaporator **50** of the circuit **46** shown in FIG. **2**. A slot **56** extends centrally along the drift eliminator **34**, to resist undesirable direct heat transfer from the tubes **54** of the condenser **48**, to the tubes **54** of the evaporator **50**.

[0040] It is contemplated that, in use, a plurality of compression refrigeration circuits, say four in number, with be provided in the cooling tower **10**, of the type shown at **46** in FIG. **2**. Each of these circuits **46** will have its compressor **44** driven by the gearbox **42**. The compressor **44** of each circuit will have its outlet connected to a multiplicity of the drift eliminators **34**, located for example in a 90° sector of the tower when seen in plan view. The upper sets of tubes **54** of the drift eliminators **34** to which said compressor is connected, will thus form the condenser **48** of the circuit **46** in question. These tubes **54** will feed into a common flow line, and will pass through the associated expansion valve **52**, whence refrigerant will return via the evaporator **50** to the compressor **44**. The evaporator **50**, similarly, comprises the various lower sets of tubes **54** in the drift eliminators **34** to which that compressor **44** is connected.

[0041] In use, hot water enters the cooling tower **10** via the pipe **23**. It is distributed in the cooling tower **10** along the riser **24**, the radial pipes **26** and their branch pipes, and issues via the sprays **28** downwardly onto the filling **22**. This hot water flows downwardly over the filling, and into the reservoir **30**, whence it is removed via the pipe **32** to be returned to its source such as the power station mentioned above.

[0042] As the water flows downwardly over the filling **22**, it heats the surrounding air, which through natural convection moves upwardly through the shell **12** of the tower **10** to issue at the top of the tower. Convective natural circulation of air is thus set up in the tower **10**, the top of the tower acting as the air outlet, and air entering through the circumferential or peripheral inlet **18** at the bottom of the shell **12**. Cool air entering the tower from the outside of the tower thus cools the water flowing downwardly over the filling **22**, both by removing sensible heat from the water, and also by removing latent heat from the water, by evaporating a proportion of the water.

[0043] In accordance with the invention, the water entering the tower via the riser **24** drives the turbine **38**, which in turn drives the compressors **44** of the various refrigeration circuits **46**. Flow of refrigerant along said circuits **46** results in evaporative cooling in the evaporators **50** of the circuits, and in condensation and rejection of heat in the condensers **48** of the circuits **46**.

[0044] Air flowing upwardly from the top of the filling **22** and over the drift eliminators **34** (see FIG. **1**.) will have been heated by the water falling over the filling **22**, and will contain a substantial proportion of water vapour. The cooling effected by the evaporators **50** will cool said rising air, resulting in condensation of a proportion of the water therein, which falls down onto the filling **22**. This cooled and dried air, upon rising further, will pass over the condensers **48** of the circuits **46**, and will then again be heated.

[0045] It will thus be appreciated that use of the refrigeration circuits **46** results in a reduced water loss with air from the top of the tower **10**, and that the reheating of the cooled dried air by the condensers **48** will serve to promote convective natural circulation of air through the tower **10**, and will at least partially offset any reduction in such convective circulation caused by the cooling of air by the evaporative coolers **50**. In this regard it will be appreciated that each drift eliminator **34** forms part of an associated refrigeration circuit **46**, its upper tubes **54** forming part of the associated evaporator **50**. As evaporation will be taking place at a lower temperature than condensation, there will be a temperature difference between the tubes **54** a the top of the drift eliminator **34** and the tubes **54** at the bottom thereof, and for this reason the slot **56** is provided to reduce direct heat transmission by conduction between said upper and lower tubes **54**. Instead, it will be appreciated that some other form of heat insulation may be provided, or, indeed, the lower tubes **54** and the upper tubes **54** may be provided on separate copper sheets, acting as drift eliminators.

[0046] Instead of using a compression refrigeration system **36**, the cooling tower **10** may employ an absorption refrigeration system. In FIG. **5**, an absorption refrigeration circuit **80** for an absorption refrigeration system is shown. The circuit **80** comprises an absorber **82** connected by a flow line **84** having a pump **86** to a heat exchanger **88**. Flow from the pump **86** through the heat exchanger **88** continues along flow line **90** to a boiler or generator **92** which is connected to a source of heating water (not shown) by flow lines **94**, **96**. A solvent return line **98** from the generator **92** passes through the heat exchanger **88** to the absorber **82**. A flow line **100** for refrigerant from the generator **92** extends to a condenser **102**, an evaporator **104** and an expansion valve **106**, the condenser **102** being connected between the expansion valve **106** and the generator **92**, and the evaporator **104** in turn being connected between the expansion valve **106** and the absorber **82**. The valve **106** is between the condenser **102** and the evaporator **104**.

[0047] With reference to FIGS. **6** and **7**, another embodiment of a drift eliminator for the tower **10** is designated **200**. The drift eliminator **200** comprises a pair of copper sheets attached together face-to-face, and shaped so that the drift eliminator **200** has two sets of tubes **202** extending along opposite longitudinal edges thereof, the drift eliminator **200** being elongate rectangular in outline. In use, the drift eliminator **200** will be arranged so that its longer edges extend horizontally, as mentioned above, and as shown in FIGS. **6** and **7**, so that the upper set of tubes **202** forms part of the condenser **102** of the absorption refrigeration circuit **80** shown in FIG. **5**, and the lower set of tubes **202** forms part of the evaporator **104** of the circuit **80** shown in FIG. **5**. The drift eliminator **200** has a central longitudinally extending corrugation **204** so that when a plurality of the drift eliminators are packed side-by-side in series in closely spaced relationships their corrugations can nest in one another. Flow between these side-by-side eliminators in a direction parallel to their faces and parallel to their short edges is thus interrupted by the corrugations **204** which reduce or prevent water droplets entrained in the flow from passing between the eliminators **200**, the droplets striking said corrugations **204**. One or more longitudinal slots **206** may be provided in each eliminator **200**, in or alongside its corrugation **204**, to resist undesirable direct heat transfer from the tubes **202** of the condenser **102** to the tubes **202** of the evaporator **104**.

[**0048**] It is contemplated that, in use, a plurality of absorption refrigeration circuits, say four in number, will be provided for the cooling tower **10**, of the type shown at **80** in FIG. **5**. Each of these circuits **80** will have its condenser **102**, valve **106** and evaporator **104** located inside the tower **10**; and will have its absorber **82**, pump **86**, heat exchanger **88** and generator **92** located outside the tower **10**. The flow line **100** will extend from the inside of the tower to the outside of the tower, to the absorber **82** and generator **92**, the flow lines **84**, **90** and **98** being located outside the tower **10**. The flow lines **94**, **96** extend to a heat source outside the tower **10** as described in more detail hereunder. The generator **92** of each circuit will have its refrigerant outlet (flow line **100**) connected to a multiplicity of the drift eliminators, in this particular instance to a quarter of the drift eliminators, located for example in a 90° C. sector of the tower **10** when seen in plan view. The upper sets of tubes **202** of the drift eliminators **200** to which said generator **92** is connected, will thus form the condenser **102** of the circuit **80** in question. These tubes **202** will feed into a common flow line **100**, and will pass through the associated expansion valve **106**, whence refrigerant will return via the evaporator **104** to the absorber **82**. The evaporator **104**, similarly comprises the various lower sets of tubes **202** in the drift eliminators **200** to which that flow line **100** is connected.

[**0049**] In use, hot water enters the cooling tower **10** to be cooled by air, as hereinbefore described. In accordance with the invention, an external heat source, such as waste heat from a power station boiler, is used to heat water to drive the absorption refrigeration circuits **80**. Thus in each circuit **80** heated water under pressure passes along flow line **94**, which can be a suitably lagged pipe, to the generator **92**. A suitable refrigerant gas, dissolved in a relatively high concentration in a suitable solvent, enters the generator **92** via flow line **90**. Heat from water from the flow line **94** boils the refrigerant gas out of the solvent in the generator **92**. Water from the flow line **94**, after cooling in the generator **92**, returns along flow line **96** to the heat source. Refrigerant gas passes along the flow line **100** to the condenser **102** where it is condensed, through the expansion valve **106** and to the evaporator **104** where it is evaporated. Solvent depleted of refrigerant from the generator **92** passes along flow line **98** through the heat exchanger **88** where it is cooled and from which it passes onto the absorber **82**. In the absorber **82** it absorbs refrigerant gas from the flow line **100** and evaporator **104**. Solvent, containing re-dissolved refrigerant gas passes from the absorber **82** along flow line **84** via pump **86** to heat exchanger **88** where it is heated, and thence via flow line **90** to the generator **92**. In this regard it is contemplated that the hot water flowing to the generator **92** along flow line **94** will typically be heated by a heat source comprising hot ash from the power station boiler, passing through suitable heat exchangers there, heating coils or the like (not shown). Flow of refrigerant along said circuits **80** results in evaporative cooling in the evaporators **104** of the circuits, and in condensation and rejection of heat in the condensers **102** of the circuits **80**.

[**0050**] Air flowing upwardly from the top of the filling **22** and over the drift eliminators **200** will have been heated by the water falling over the filling **22**, and will contain a substantial proportion of water vapour. The cooling effected by the evaporators **104** will cool said rising air, resulting in condensation of a proportion of the water therein, which falls down on to the filling **22**. This cooled and dried air, upon rising further, will pass over the condensers **102** of the circuits **80**, and will then again be heated.

[**0051**] It will thus be appreciated that use of the refrigeration circuits **80** results in a reduced water loss with air from the top of the tower **10**, and that the re-heating of the cooled dried air by the condensers **102** will serve to promote convective natural circulation of air through the tower **10**, and will at least partially offset any reduction in such convective circulation caused by the cooling of air by the evaporative coolers **104**. In this regard it will be appreciated that each drift eliminator **200** forms part of an associated refrigeration circuit **80**, its upper tubes **202** forming part of the associated condenser, and its lower tubes **202** forming part of the associated evaporator. As evaporation will be taking place at a lower temperature than condensation, there will be a temperature difference between the tubes **202** at the top of the drift eliminator **200** and the tubes **202** at the bottom thereof, and for this reason the slots **206** are provided to reduce direct heat transmission by conduction between said upper and lower tubes **202**. Instead, it will be appreciated that some other form of heat insulation may be provided, or, indeed, the lower tubes **202** and the upper tubes **202** may be provided on separate copper sheets, acting as drift eliminators.

[**0052**] The invention is intended for use where availability of water can be critical, as in thermal power stations, which have a limited water supply, and which have to close down should this water supply run out. In this regard it will be appreciated that the power to drive the circuits **80** is obtained from incoming hot water in the line **94**, and eventually must be obtained from waste heat from the power station. It is however believed that, where water shortage is a critical factor, the present invention can have substantial utility and in this regard it should be noted that the invention requires no additional water consumption, bearing in mind that flow lines **94**, **96** form part of a closed water circuit. The power to drive the compressors **44** of the circuits **46** is obtained from the incoming hot water in the risers **24**, and eventually must be obtained by the pumps pumping such incoming water. However, if desired, the power for the compressors **44** may be provided in some other fashion, for example by means of a suitable electric motor, conveniently located outside the tower **10**, and connected to the gearbox **42** of FIG. **2**, or the like.

[**0053**] Although the invention, i.e. the cooling of air above the filling to resist water loss, has been described with reference to natural draught cooling towers, it will be appreciated that this method is in principle equally applicable to forced draught cooling towers and the invention accordingly extends thereto.

1. A method of operating an evaporative natural draught cooling tower which has upwardly moving air, the method including

contacting water with air in a cooling zone to cool the water and heat the air;

cooling the heated air by means of evaporative cooling provided by a compression refrigeration system or an absorption refrigeration system, with the refrigeration system including a condenser and an evaporator arranged in a circuit, the evaporator being at a low elevation inside the cooling tower to cool the upwardly moving air and remove water therefrom by condensation; and

above the level of cooling of the heated air, heating the upwardly moving dried air with the condenser, to promote the draught in the tower.

2. The method as claimed in claim 1, in which the cooling tower employs filling with drift eliminators above the filling in the tower, the evaporator comprising one or more coils in or on one or more drift eliminators and the condenser comprising one or more coils in or on one or more drift eliminators located above the evaporator coil or coils.

3. In a natural draught cooling tower of the type used for large scale water cooling as in the cooling of water used by thermal power stations, and which comprises a typically concrete hollow shell which is circular in plan view and has walls which are concave and parabolic in side view outline, the bottom of the tower being raised from ground level on stilts or the like to provide a circumferentially extending air inlet at its lower end and the tower containing filling at its lower end and a water distribution system for distributing water to be cooled onto the filling from which it drains into a reservoir under the tower while air circulates from the inlet up over the filling and out of the top of the tower by natural convection to cool the water, there is provided the method of operation which comprises, above the filling, cooling the upwardly moving air to condense water therefrom, thereby to reduce water loss from the tower at its top, and above the level of cooling of the upwardly moving air, heating the upwardly moving air to promote the draught in the cooling tower, the cooling of the upwardly moving air being by evaporative cooling provided by a compression refrigeration system or an absorption refrigeration system, with the refrigeration system including a condenser and an evaporator arranged in a circuit, the evaporator being located above the filling in the tower to cool the upwardly moving air and remove water therefrom by condensation, and the condenser being located above the evaporator to heat the upwardly moving air, which is dried air, to promote the draught in the tower.

4. The method as claimed in claim 3, in which the cooling tower employs drift eliminators above the filling in the tower and the evaporator of the refrigeration circuit comprises one or more coils in or on one or more drift eliminators, and the condenser of the refrigeration circuit comprises one or more coils in or on one or more drift eliminators, located above the evaporator coil or coils.

5. An evaporative cooling tower which includes a cooling zone for contacting water with air to cool the water and heat the air, and a refrigeration or cooling system for cooling the heated air from the cooling zone for condensing water therefrom, the refrigeration system being a compression refrigeration system for the evaporative cooling of the air by means of a refrigerant, the refrigeration system being an arranged to heat the cooled air at a level above that at which the refrigeration system cools said air.

6. The cooling tower as claimed in claim 5, in which the refrigeration system comprises one or more cooling circuits, each comprising a condenser and an evaporator.

7. The cooling tower as claimed in claim 6, which includes filling and drift eliminators, each evaporator comprising coils in or on one or more drift eliminators above the filling in the tower, and each condenser comprising coils in or on one or more drift eliminators above the filling, the condenser coils being at a higher level than the evaporator coils.

8. The cooling tower as claimed in claim 6, in which each cooling circuit includes a compressor which is driven by a turbine and optionally via a gearbox, the gearbox, when present, being between the turbine and the compressor, and the turbine being driven by an incoming stream of water to be cooled as it enters the cooling tower.

9. An evaporative cooling tower which includes a cooling zone for contacting water with air to cool the water and heat the air, and a refrigeration or cooling system for cooling the heated air from the cooling zone for condensing water therefrom, the refrigeration system being an absorption refrigeration system for the evaporative cooling of the air by means of a refrigerant, the refrigeration system being arranged to heat the cooled air at a level above that at which the refrigeration system cools said air.

10. The cooling tower as claimed in claim 9, in which the refrigeration system comprises one or more cooling circuits, each comprising a generator, a condenser and an evaporator, with each circuit having its generator located outside the cooling tower.

11. The cooling tower as claimed in claim 9, which includes filling and drift eliminators, each evaporator comprising coils in or on one or more drift eliminators above the filing in the tower, and each condenser comprising coils in or on one or more drift eliminators above the filling, the condenser coils being at a higher level than the evaporator coils.

12. A natural draught cooling tower of the type used for large scale water cooling as in the cooling of water used by thermal power stations, and which comprises a typically concrete hollow shell which is circular in plan view and has walls which are concave and parabolic in side view outline, the bottom of the tower being raised from ground level on stilts or the like to provide a circumferentially extending air inlet at its lower end and the tower containing filling at its lower end and a water distribution system for distributing water to be cooled onto the filling from which it drains into a reservoir under the tower while air circulates from the inlet up over the filing and out of the top of the tower by natural convection to cool the water, the cooling tower further including a refrigeration system for cooling upwardly moving air in the tower above the filling, for condensing water therefrom,

13. The cooling tower as claimed in claim 12, in which the refrigeration system is a compression refrigeration system for the evaporative cooling of the upwardly moving air by means of a refrigerant, the refrigeration system being arranged to heat the cooled upwardly moving air at a level above that at which the refrigeration system cools said air.

14. The cooling tower as claimed in claim 13, in which the refrigeration system comprises one or more cooling circuits, each comprising a condenser and an evaporator.

15. The cooling tower as claimed in claim 14, in which each evaporator comprises coils in or on one or mote drift eliminators above the filling in the tower, and each condenser comprises coils in or on one or more drift eliminators above the filling, the condenser coils being at a higher level than the evaporator coils.

16. The cooling tower as claimed in claim 15, in which each cooling circuit includes a compressor which is driven by a turbine and optionally via a gearbox, the gearbox, when present, being between the turbine and the compressor, and the turbine being driven by an incoming stream of water to be cooled as it enters the cooling tower.

17. The cooling tower as claimed in claim 12, in which the refrigeration system is an absorption refrigeration system for the evaporative cooling of the air by means of a refrigerant, the refrigeration system being arranged to heat the cooled upwardly moving air at a level above that at which the refrigeration system cools said air.

18. The cooling tower as claimed in claim 17, in which the refrigeration system comprises one or more cooling circuits, each comprising a generator, a condenser and an evaporator, with each circuit having its generator located outside the cooling tower.

19. The cooling tower as claimed in claim 18, in which each evaporator comprises coils in or on one or more drift eliminators above the filling in the tower, and each condenser comprises coils in or on one or more drift eliminators above the filling, the condenser calls being at a higher level than the evaporator coils.

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