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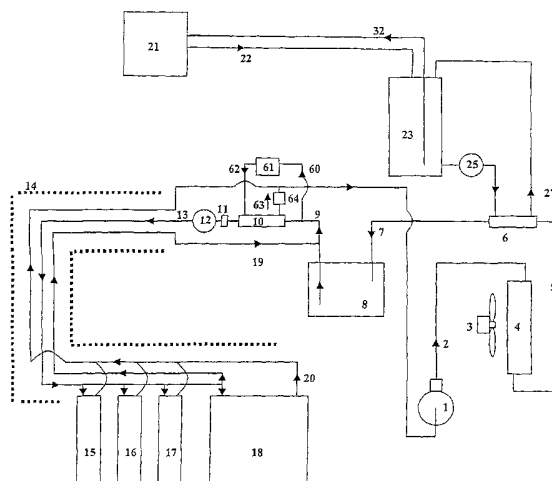
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(54) Title: COOLING PLANT



(57) Abstract: Compressors (1) supply a primary air-cooled condenser (4) which is followed by an indirect heat exchanger (6), a liquid receiver (8) and a second indirect heat exchanger (10) acting as a refrigerant sub-cooler. A pump (12) supplies sub-cooled refrigerant to remote cooling devices (15, 18) and a bypass line (19) is provided to recirculate a proportion of the refrigerant through the sub-cooler (10), thereby maintaining a flow of cooled refrigerant in the distribution network even when there is no cooling demand. The distribution and return pipes are enclosed within a common temperature environment provided by a thermal insulation sheath (14). Secondary cooling circuits (21) operate off-peak to create pumpable ice slurry in an ice store (23) which is used to cool the indirect heat exchanger (6). The heat exchanger (6) acts as an additional condenser under hot ambient conditions. Systems are also described in which the ice store is eliminated with direct heat exchange between the primary and secondary cooling systems, and in which the cooling devices (15, 18) are supplied through a cooling loop containing an indirectly-cooled non-hydrocarbon heat exchange medium.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 02/03647

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F25B41/00 F25B25/00

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)

IPC 7 F25B

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

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

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	NL 1 000 899 C (KEMPEN KOUDETECHNIEK B V VAN) 28 August 1996 (1996-08-28)	1,2,5, 11,12, 22,23
Y	abstract	3,24
A	page 2, line 31 -page 4, line 23 page 7, line 3 - line 6 figure 1	4
Y	--- PATENT ABSTRACTS OF JAPAN vol. 015, no. 257 (M-1130), 28 June 1991 (1991-06-28) & JP 03 084341 A (SANYO ELECTRIC CO LTD), 9 April 1991 (1991-04-09) abstract figure 3 --- -/--	3,24

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

2 December 2002

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International Application No

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 845 642 A (CARRIER CORP) 3 June 1998 (1998-06-03) abstract figure 1 ---	22,23
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A	GB 2 236 587 A (RADDERS LIMITED) 10 April 1991 (1991-04-10) abstract ---	3,24
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A	US 6 145 326 A (O'BRIEN DANIEL JAMES) 14 November 2000 (2000-11-14) ---	
A	US 4 748 820 A (SHAW DAVID N) 7 June 1988 (1988-06-07) -----	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 02/03647

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-5, 11, 12, 22-24

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-5 11 12 22-24

(Claims 1-5,11,12)

Cooling plant having a primary cooling circuit including at least one compressor and an externally cooled heat exchanger arranged to supply refrigerant to cooling means which comprises at least one cooling device, characterized in that

- 1) the primary cooling circuit includes a refrigerant sub-cooler and
- 2) a circulation pump arranged to supply sub-cooled refrigerant to said cooling means and
- 3) a bypass line is provided to return a proportion of the refrigerant from the output of said circulation pump to said sub-cooler such as to maintain a continuous recirculation of coolant through the sub-cooler irrespective of the cooling demand of said cooling means.

(Claims 22-24)

Cooling plant having a primary cooling circuit including at least one compressor and an externally cooled heat exchanger arranged to supply refrigerant to cooling means which comprises at least one cooling device, characterized in that

- 1) liquid refrigerant from the externally cooled heat exchanger passes through a refrigerant sub-cooler to supply sub-cooled liquid refrigerant to the cooling means,
- 2) the refrigerant sub-cooler comprises an indirect heat exchanger,
- 3) a proportion of the liquid refrigerant from the primary circuit passes through an expansion device to cool the indirect heat exchanger, and the spent refrigerant from the indirect heat exchanger is returned to said at least one compressor.

2. Claims: 6-10 13-21

(Claims 6-10)

Cooling plant having a primary cooling circuit including at least one compressor and an externally cooled heat exchanger arranged to supply refrigerant to cooling means which comprises at least one cooling device, characterized in that

- 1) the primary cooling circuit includes a refrigerant sub-cooler and
- 2) a circulation pump arranged to supply sub-cooled refrigerant to said cooling means and
- 3) a bypass line is provided to return a proportion of the refrigerant from the output of said circulation pump to said sub-cooler such as to maintain a continuous recirculation of coolant through the sub-cooler irrespective of the cooling demand of said cooling means, which includes a
- 4) secondary cooling system of the vapour compression type which is thermally coupled to the primary cooling circuit to

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

cool the refrigerant of the primary cooling circuit.

(Claims 13-21)

Cooling plant having a primary cooling circuit including at least one compressor and an externally cooled heat exchanger arranged to supply refrigerant to cooling means which comprises at least one cooling device, and

1) a secondary cooling system of the vapour compression type which is thermally coupled to the primary cooling circuit by heat exchange means to cool the refrigerant of the primary cooling circuit, characterized in that

2) the heat exchange means is arranged in series with the externally cooled heat exchanger to receive cooled refrigerant therefrom.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 02/03647

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