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Published:

— *with international search report (Art. 21(3))*

[Continued on next page]

(54) **Title**: METHODS FOR CONTROLLING TEMPERATURES IN THE ENVIRONMENTS OF GAS AND OIL WELLS

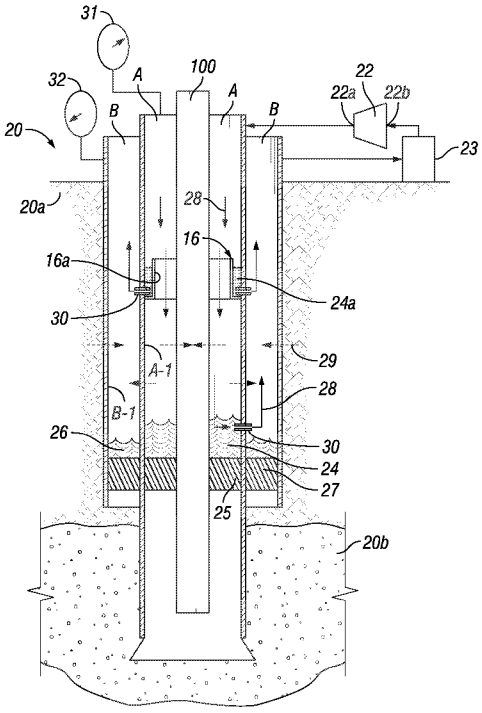


FIG. 10

(57) **Abstract**: Methods and apparatus are provided for controlling temperatures in the environments of oil, gas condensate, or gas wells. Methods are provided for reducing the melting of glaciers and ice dams through the deployment of hydrate-forming substances. Active methods involve employing a vapor-compression refrigerator/heat pump cycle in an annulus lying between the relatively hot production string and the relatively cold outer pipe. Passive methods include: deploying cold hydrate-forming fluids into the external ice-laden environment of an oil, gas condensate, or gas well in a permafrost area and allowing those hydrate forming fluids to mix with any melt-water that may be present or that may subsequently form due to the loss of heat from the oil, gas condensate, or gas well. Mixtures of the hydrate forming fluids and the melt- water will set up into a solid having a much higher melting point and a much lower thermal conductivity than those of ice.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:
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A. CLASSIFICATION OF SUBJECT MATTER

E21B 36/00(2006.01)i, E21B 43/24(2006.01)i

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)

E21B 36/00; E21B 43/24; E21B 43/16; F25C 1/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: hydrate, weir, groove

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3989108 A (ALLEN; JOSEPH C.) 02 November 1976 See column 3 and figure 1.	1-3
Y	US 4398394 A (KLEINER; FREDRIC et al.) 16 August 1983 See the abstract.	1-3
X	See the abstract.	4-6
A	US 3990502 A (BEST; JOHN S.) 09 November 1976 See the whole document.	7-22
A	US 7367399 B2 (STEELE DAVID JOE et al.) 06 May 2008 See the whole document.	7-22
A	WO 2006-116095 A1 (SHELL OIL COMPANY et al.) 02 November 2006 See the whole document.	7-22

☐ Further documents are listed in the continuation of Box C.

☒ See patent family 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 application or patent 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 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	Date of mailing of the international search report
29 SEPTEMBER 2010 (29.09.2010)	**29 SEPTEMBER 2010 (29.09.2010)**

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INTERNATIONAL SEARCH REPORT

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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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 No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

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

Claims 1-6(Group I) are directed to a method for mitigating ice melting effects or reducing ice melt, using a cold hydrate-forming fluids

Claims 7-22(Gruop II) are directed to an apparatus (system) or method of well thermal management in an annulus of oil, gas or the like.

1. ☐ As all required addtional 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.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

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