Patents Act 1977 **Opinion Number** **17/17**

OPINION UNDER SECTION 74A

Patent	GB 2517725 B
Proprietor(s)	Intelliheat Solutions
Exclusive Licensee	
Requester	Barker Brettell LLP
Observer(s)	Marks & Clerk LLP
Date Opinion issued	16 January 2018

The request

1. The comptroller has been requested by Barker Brettell LLP ("the requester") to issue an opinion as to whether patent GB 2517725 B ("the patent") is valid in light of the following documents:

   D1: "Design of a heater for natural gas stations assisted by two-phase loop thermosyphon", Angelo et al. 14th International Heat Pipe Conference (14th IHPC) 2007.

   D2: US 2007/000453 A1 (KING et al.)

2. D2 was cited under novelty by the examiner during pre-grant proceedings. The requester refers to D2 when discussing the obviousness of dependent claims. I do not consider the reference to D2 to be merely repeating arguments already considered pre-grant and have therefore taken account of D2 when considering the requester's arguments.

Observations

3. Observations have been received from Marks & Clerk LLP ("the observer") detailing how the claims of the patent are not anticipated by or obvious in light of the alleged prior art filed by the requester.

Observation in reply

4. The requester has provided observations in reply to counter what has been said in the observations along with copies of US 1845023 (JENNINGS) and WO 2008/026960 A1 (LIPOVYI et al.) as further support of their argument regarding the

validity of dependent claims 5 and 17 respectively. LIPOVYI was cited under novelty by the examiner during pre-grant proceedings but did not form part of the argument put forward by the requester in the initial request.

5. I need to consider whether JENNINGS and LIPOVYI are strictly observations in reply as required by Rule 96 of the Patent Rules. Whilst these documents were submitted in response to the observations filed by the observer, that is not in itself sufficient for them to be treated as evidence in reply. Having considered the matter carefully, I have concluded that they are not strictly evidence in reply. They are not directed to any evidence provided by the observer but rather are intended to strengthen the case initially advanced by the requester. The requester could have provided this additional evidence in their request but did not do so. If they had then the observer would have had an opportunity to make observations on it. The observer would be denied that opportunity if I allowed the documents to be introduced at this stage. That would be unfair to the patentee and hence I will not consider them for the purposes of this opinion.

The Patent

6. The patent, GB 2517725 B, is titled “Heater suitable for heating a flow of natural gas”. It was filed on 29th August 2013, published on 4th March 2015 and granted on 2nd August 2017. The patent remains in force.

7. The patent relates to a heater suitable for heating a flow of natural gas. Natural gas is typically transported in pipelines over large distances at high pressures e.g. 17 to 75 bar gauge. For domestic consumption, the gas must be let-down from the pipeline pressures to lower pressures (e.g. 2 to 7 bar gauge) in a pressure reducing station. Natural gas typically enters the pressure reducing station at 4 to 6°C. Pressure let-down of the gas from such temperatures and pressures can result in the temperature of the gas falling below the condensation temperature (e.g. 0°C), causing gas hydrates to form downstream of the pressure reducing station, which may lead to equipment damage or pipeline blockage.Therefore, preheaters have been used to heat the natural gas before it enters the pressure reducing station in order to maintain temperature of the gas leaving the pressure reducing station above the condensation temperature (e.g. 0°C).

8. It has been found that direct heating of the natural gas in the pipeline using for example hot flue gases is difficult to control and therefore potentially unsafe because the pipeline and gas may become overheated. Therefore, ways of heating the pipeline indirectly, using a heat transfer fluid have been proposed.

9. With reference to figure1 reproduced below, the Patent describes a heater 1 suitable for heating a flow of natural gas comprises an evaporator vessel 2 containing a heat transfer fluid (not shown) and a heat source tube 3 passing through the evaporator vessel 2 and being immersed in the heat transfer fluid. The heat source tube 3 is connectable to a source of heated gas to allow the heated gas to flow along the heat source tube 3 to evaporate the heat transfer fluid. A condenser vessel 13 is in fluid communication with the evaporator vessel 2 to allow the evaporated heat transfer fluid to flow between the evaporator vessel 2 and the condenser vessel 13. The heater 1 further comprises a heat exchanger in the form of a heat transfer tube 5

passing through the condenser vessel 13, the heat transfer tube 5 being connected to a source of natural gas 9 to be heated. The heat transfer tube 5 being arranged to be heated by the evaporated heat transfer fluid.

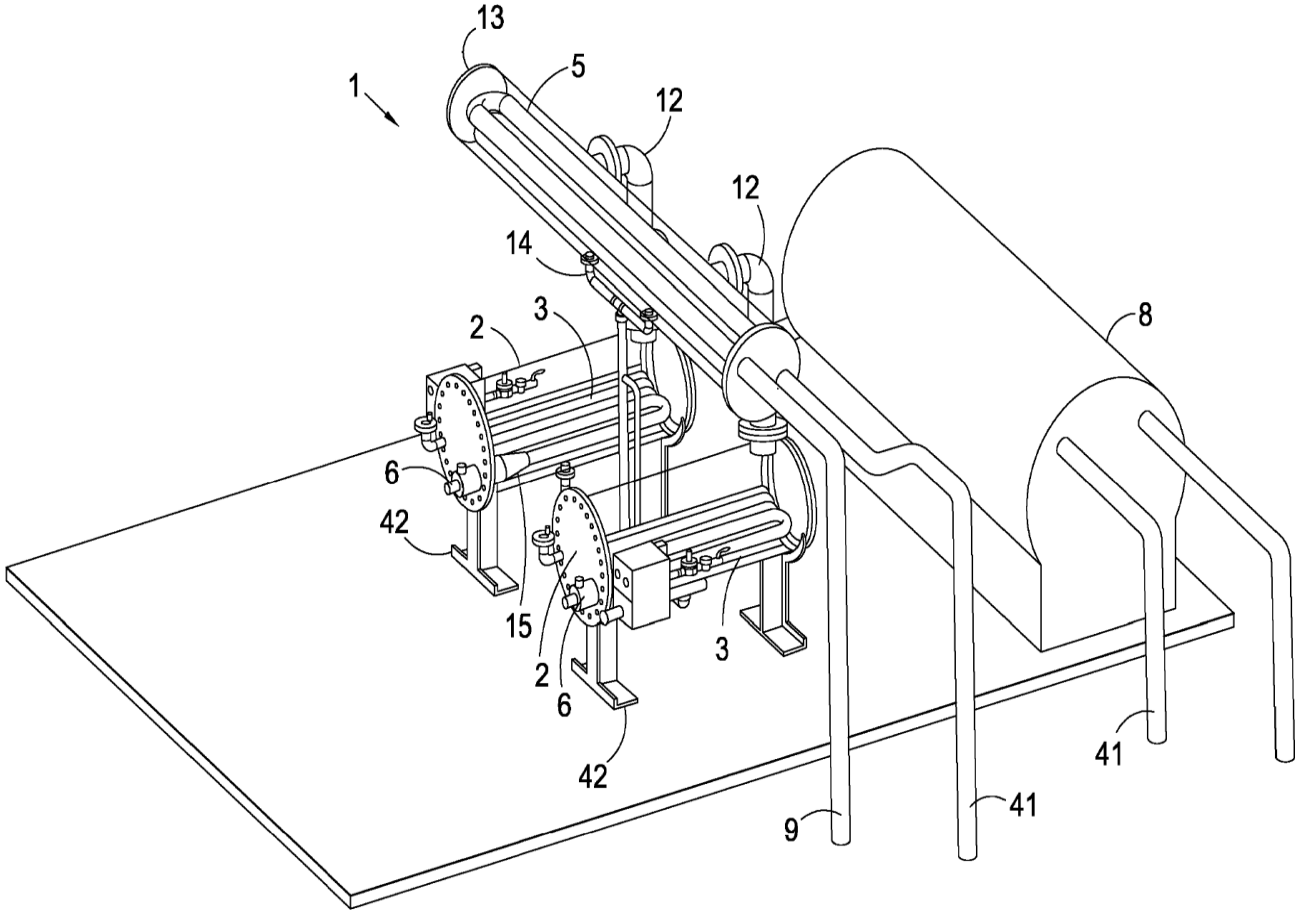


Fig.1

10. The source of heated gas is a burner 6 which has a blower or fan 7 to force the heated gas along the heat source tube 3. As the heated gas passes along the heat source tube 3 heat is transferred from the heated gas flow inside the heat source tube 3 to the heat transfer fluid outside the heat source tube 3 through the walls of the heat source tube 3. The heat transfer from the heated gas flow causes the heat transfer fluid to evaporate. The heat transfer fluid then rises in the evaporator vessel 2 due to natural convection and passes out of the evaporator vessel 2 into the riser 12. The riser 12 connects the evaporator vessel 2 and the condenser vessel 13. The heat transfer fluid vapour then passes into the condenser vessel 13. Inside the condenser vessel 13 the hot heat transfer fluid vapour encounters the cold heat transfer tube 5 containing a flow of natural gas to be heated. The heat transfer fluid condenses on the outer surface of the heat transfer tube 5, thereby transferring its latent and sensible heat to the flow of natural gas and heating the natural gas. The condensed heat transfer fluid passes to the bottom of the condenser vessel 13 by gravity. A downcomer pipe 14 is connected to the bottom of the condenser vessel 13 and connects the condenser vessel to the evaporator vessel 2 to return the condensed heat transfer fluid back to the evaporator vessel 2. There is a control

system for the burner to control the circulation rate of the heated gas in the heat source tube 3.

11. The patent has eighteen claims – one independent claim and seventeen claims dependent thereon. Independent claim 1 reads as follows:

> *1. A heater suitable for heating a flow of a first gas, the first gas being a natural gas, the heater comprising:*
>
> *an evaporator vessel containing a heat transfer fluid;*
>
> *a heat source tube passing through the evaporator vessel and being at least partially immersed in the heat transfer fluid, the heat source tube being suppliable with a heated second gas, the heat source tube being configured to allow the heated second gas to flow along and inside the heat source tube to evaporate the heat transfer fluid;*
>
> *a condenser vessel, separate from the evaporator vessel, being in fluid communication with the evaporator vessel to allow the evaporated heat transfer fluid to flow between the evaporator vessel and the condenser vessel; and*
>
> *at least one heat transfer tube passing through the condenser vessel, the at least one heat transfer tube being connectable to a source of the first gas so that the first gas can flow inside the at least one heat transfer tube, the at least one heat transfer tube being arranged to be heated by the evaporated heat transfer fluid to heat the first gas,*
>
> *the heater further comprising a burner to supply the heated second gas to the heat source tube, and a control system for the burner to control the circulation rate of the heated second gas in the heat source tube.*

12. I will consider the novelty and inventive step of the dependent claims should that become necessary after my assessment of claim 1.

Novelty and Inventive step – the law

13. Section 1(1)(a) and (b) of the Patents Act (henceforth 'the Act') reads:

> *1(1) A patent may be granted only for an invention in respect of which the following conditions are satisfied, that is to say –*
> *(a) the invention is new;*
> *(b) it involves an inventive step;*

14. The relevant provisions in relation to novelty are found in section 2(1) and section 2(2) which read:

> *2(1) An invention shall be taken to be new if it does not form part of the state of the art.*
>
> *2(2) The state of the art in the case of an invention shall be taken to comprise all matter (whether a product, a process, information about either, or anything else) which has at any time before the priority date of that invention been made available to the public (whether in the United Kingdom*

or elsewhere) by written or oral description, by use or in any other way.

15. The provisions in relation to inventive step are found in section 3 which states:

> *3. An invention shall be taken to involve an inventive step if it is not obvious to a person skilled in the art, having regard to any matter which forms part of the state of the art by virtue only of section 2(2) above (and disregarding section 2(3) above).*

16. The Court of Appeal in Windsurfing[1] formulated a four-step approach for assessing whether an invention is obvious to a person skilled in the art. This approach was restated and elaborated upon by the Court of Appeal in Pozzoli[2]. Here, Jacob LJ reformulated the Windsurfing approach as follows:

> *(1)(a) Identify the notional "person skilled in the art"*
> *(1)(b) Identify the common general knowledge of that person;*
> *(2) Identify the inventive concept of the claim in question or if that cannot be readily done, construe it;*
> *(3) Identify what, if any, differences exist between the matter cited as forming part of the "state of the art" and the inventive concept of the claim or the claim as construed.*
> *(4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps that would have been obvious to the person skilled in the art or do they require any degree of invention?*

17. I will begin by considering the validity of the invention as defined by claim 1. Only if I find it to be invalid will I consider the remaining dependent claims.

Claim construction

18. Before considering the documents put forward in the request I need to construe claim 1 of the Patent, that is to say I must interpret it in the light of the description and drawings as instructed by Section 125(1). In doing so I must interpret the claims in context through the eyes of the person skilled in the art. Ultimately the question is what the person skilled in the art would have understood the patentee to be using the language of the claims to mean. This approach has been confirmed in the recent decisions of the High Court in Mylan v Yeda[3] and the Court of Appeal in Actavis v ICOS[4].

19. Neither the requester nor the observer has filed any argument concerning the construction of claim 1. In my opinion the claim is clear and straightforward and a person skilled in the art would have no difficulty in construing the scope of the claim.

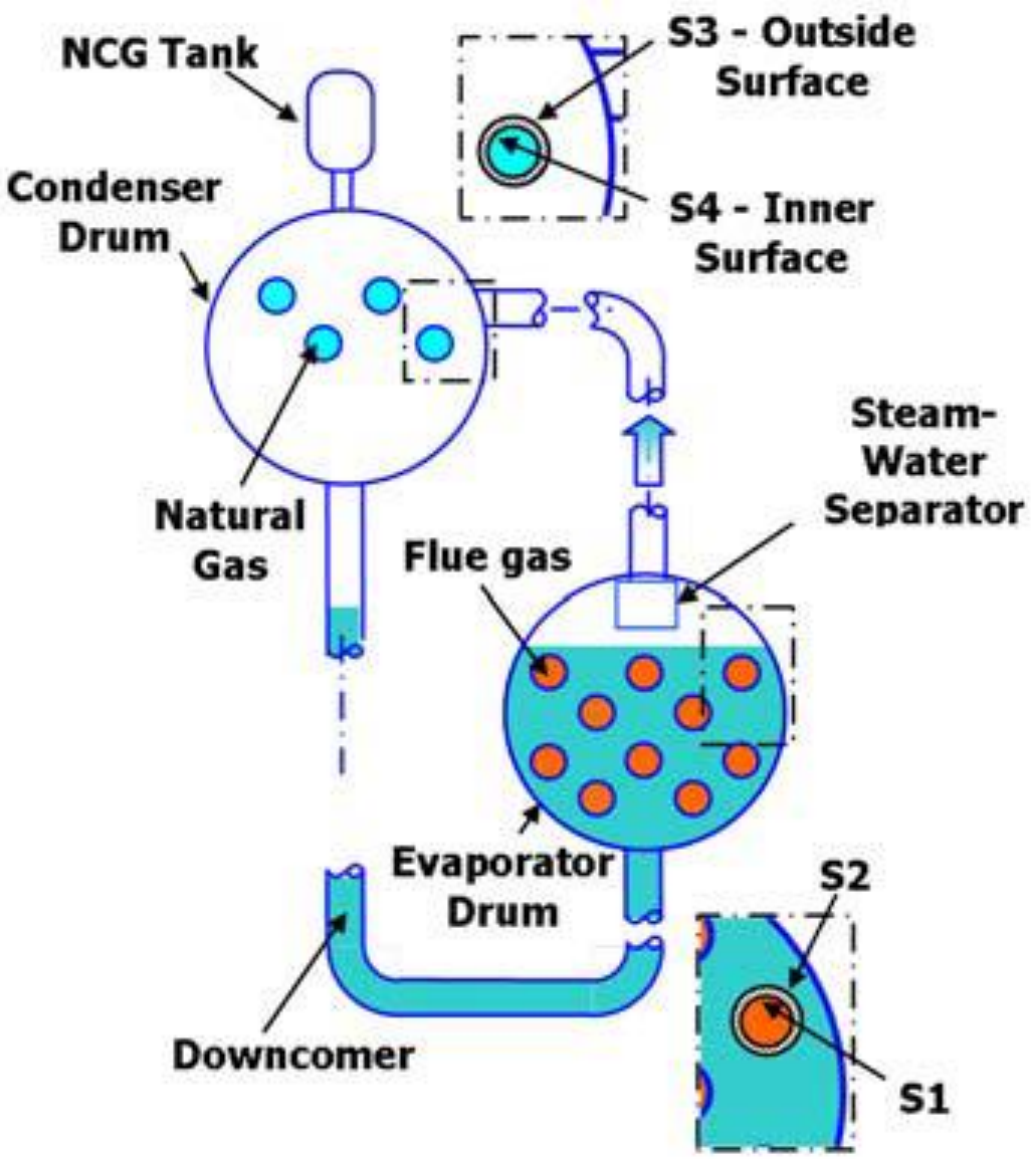
---

[1] Windsurfing International Inc. v Tabur Marine (Great Britain) Ltd, [1985] RPC 59
[2] Pozzoli SPA v BDMO SA [2007] EWCA Civ 588
[3] Generics UK Ltd (t/a Mylan) v Yeda Research and Development Co. Ltd & Anor [2017] EWHC 2629 (Pat)
[4] Actavis Group & Ors v ICOS Corp & Eli Lilly & Co. [2017] EWCA Civ 1671

The heater of D1

20. D1 is a paper titled “Design of a heater for natural gas stations assisted by two-phase loop thermosyphon” which according to the requester was presented at the 14th International Heat Pipe Conference which was staged from 22-27 April 2007 which pre-dates the filing date of the Patent.

21. D1 discloses a heater for natural gas stations. Figure 3 of D1 is reproduced below and shows the heater comprising an evaporator drum containing a heat transfer fluid (in this case water) and flue gas tubes passing through the evaporator drum and being immersed in the heat transfer fluid. The flue gas tubes are connectable to a source of flue gas to allow the flue gas to flow along the flue gas tubes to evaporate the water. A condenser drum is in fluid communication with the evaporator drum to allow the evaporated water to flow between the evaporator drum and the condenser drum. The heater further comprises a heat exchanger in the form of a heat transfer tube containing natural gas passing through the condenser drum, the heat transfer tube being connected to a source of natural gas to be heated. The heat transfer tube is heated by the evaporated water.



22. D1 discloses the source of the flue gas to be a burner 6. As the heated gas passes along the flue gas tubes heat is transferred from the flue gas flow inside the tubes to the water outside the tubes. The heat transfer from the flue gas flow causes the water to evaporate. The water then rises in the evaporator drum due to natural convection and passes out of the evaporator drum into the pipe connecting the evaporator drum to the condenser drum. The water vapour then passes into the condenser drum. Inside the condenser drum the hot water vapour encounters the cold tubes containing a flow of natural gas to be heated. The water condenses on the outer surface of the natural gas tubes, thereby transferring its latent and sensible heat to the flow of natural gas and heating the natural gas. The condensed water passes to the bottom of the condenser drum by gravity. A downcomer pipe is connected to the bottom of the condenser drum and connects the condenser drum to the evaporator drum to return the condensed water back to the evaporator drum.

Does D1 disclose all of the features of claim 1?

23. The requester has argued that D1 discloses all of the features of claim 1 and has provided a detailed breakdown of the claim and where each of the features can be found in D1. The observer has focussed their argument on whether D1 discloses the feature of:

> *"and a control system for the burner to control the circulation rate of the heated second gas in the heat source tube."*

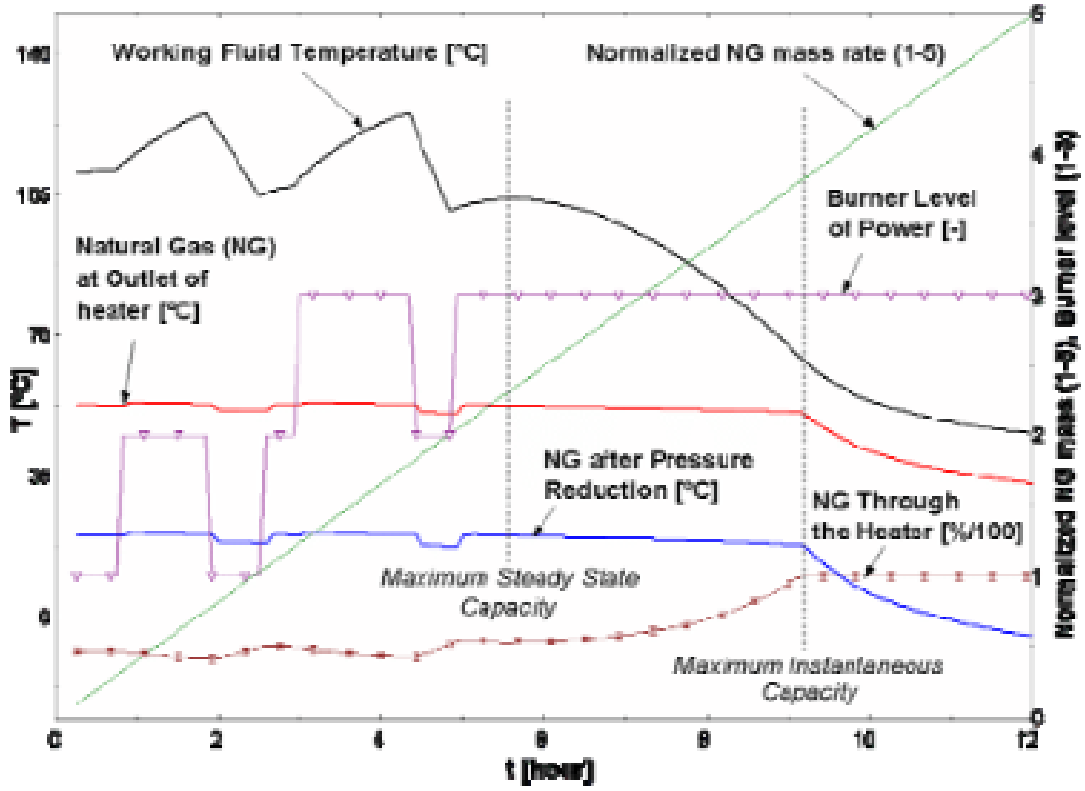
The observer argues that D1 does not disclose this feature and thus not all of the features of claim 1.Therefore the only contention lies around whether D1 discloses this feature or not.

24. However, before considering this point, I will consider the other features of claim 1. Having considered the detailed argument put forward by the requester in the initial request and the discussion of D1 above it is my opinion that the D1 clearly discloses all of the other features of claim 1.

25. Turning to the feature highlighted above, the observer has argued that whilst D1 discloses a burner operating at multiple burner levels this does not equate to a disclosure of a control system for the burner to control the circulation rate of the heated second gas in the heat source tube.

26. The requester relies on the abstract and the second paragraph of 3.1 of D1 as disclosing the feature. The requester argues D1 describes the burner as having four levels, each of which corresponds to a different "circulation rate" of the heated flue gas in the sense of the Patent. Something is clearly controlling the burner to have the different levels and as such is controlling the circulation rate. The something is therefore a control system as required by claim 1.

27. Figure 5 of D1 is reproduced below and shows the burner to operate at multiple levels i.e. levels 1-3.



28. The sections of D1 highlighted by the requester along with figure 5 clearly disclose the burner operating at multiple levels. In my opinion it is implicit that there must be some form of control system controlling the burner to switch between the multiple operating levels.

29. However does the control system control the circulation rate of the flue gas in the flue gas tubes as required by claim 1? Each of the burner levels heats the flue gas to different temperatures. At each of these different temperatures the flow rate of the flue gas in the flue gas tubes will be different. Therefore I agree with the requester that the different burner levels correspond to different circulation rates and thus the control system controlling the burner is controlling the circulation rate of the flue gas in the flue gas tubes.

30. I am therefore of the opinion that D1 anticipates claim 1.

The dependent claims

31. Having considered claim 1 to be anticipated by D1 I will now consider the dependent claims which read as follows:

> *2. A heater according to claim 1, wherein the condenser vessel is in fluid communication with the evaporator vessel to allow heat transfer fluid to flow between the evaporator vessel and the condenser vessel in a circuit.*
>
> *3. A heater according to claim 2, wherein the circuit comprises a feed*

tube for evaporated heat transfer fluid and a return tube for condensed heat transfer fluid.

4. A heater according to claim 1, 2, or 3, wherein the centre of gravity of the condenser vessel is above the centre of gravity of the evaporator vessel in the operating condition of the heater.

5. A heater according to any one of claims 1 to 4, wherein the pressure in the evaporator vessel is maintained below atmospheric pressure.

6. A heater according to any preceding claim, wherein the heat transfer fluid comprises water.

7. A heater according to any preceding claim, wherein the heat transfer fluid comprises propylene glycol or ethylene glycol.

8. A heater according to any preceding claim, wherein the evaporator vessel is substantially cylindrical.

9. A heater according to claim 8, wherein the cylindrical evaporator vessel has a longitudinal axis, and the evaporator vessel is arranged so that the longitudinal axis is substantially horizontal in the operating condition of the heater.

10. A heater according to any preceding claim, not further comprising a pump for moving the heat transfer fluid.

11. A heater according to any preceding claim, wherein the heat source tube follows an at least partially curved path inside the vessel.

12. A heater according to any preceding claim, wherein the heat source tube overlaps itself.

13. A heater according to any preceding claim, wherein the heat source tube follows a sinuous path.

14. A heater according to any preceding claim, wherein the heat source tube has an inlet where the heat source tube enters the evaporator vessel and an outlet where the heat source tube leaves the vessel, and the heat source tube is tapered in the direction inlet to outlet.

15. A heater according to any preceding claim, wherein a single heat source tube passes through the vessel.

16. A heater according to any preceding claim, wherein the heat source tube follows a substantially horizontal path inside the vessel in the operating condition of the heater.

17. A heater according to any preceding claim, further comprising a fan, pump or blower to force the heated gas along the heat source tube.

18. A heater according to any preceding claim, wherein the control system is configured to control the burner based on achieving a required set point temperature of the first gas.

32. In the initial request the requester argues that all of dependent claims 2-18 were either not novel or obvious in light of D1. In their observations the observer has countered that claims 5, 11-14 and 17-18 are in fact novel and inventive. However no observations were filed regarding the validity of claims 2-4, 6-10 and 15-16.

33. Looking at claims 2-4, 6-10 and 15-16 first, I find myself in agreement with the requester's arguments that dependent claims 2-4, 6, 8, 10 and 16 are anticipated by D1 and that dependent claims 7, 9 and 15 are obvious in light thereof.

34. Claim 5 requires the evaporator vessel is maintained below atmospheric pressure. The requester refers to the paragraph above figure 3 in D1 which states "that if the heater works at pressures below atmosphere ..." as disclosing the features of claim 5 since the passage discloses use of the heater below atmospheric pressure. The observer argues that the passage mentions using below atmospheric pressure as causing problems such as the leakage of air into the evaporator vessel which could reduce the reliability and lifetime of the equipment. Therefore it is argued D1 dismisses using below atmospheric pressure. Whilst D1 does discusses problems with the heater working at below atmospheric pressures, it never the less does disclose it operating at such pressure and thus I agree with the requester that D1 anticipates the subject matter of claim 5.

35. Claims 11-13 define features of the heat source tube. The observer argues that D1 discloses the natural gas pipe as serpentine within the condenser drum. However there is no disclosure of the heat source tube i.e. the flue gas tube, being serpentine within the evaporator drum. The features of claims 11-13 mean that the heat source tube can be more tightly packed into the evaporator vessel, resulting in increased heat transfer and a lower volume of heat transfer fluid. The requester has replied by arguing that having a tube in a heat exchanger follow a convoluted path in order to have maximum path length and so heat exchange area is increased cannot be considered inventive. Furthermore D1 discloses such a path shape with regard to the natural gas tube being serpentine with the condenser drum and as such teaches the skilled addressee that such path shapes would be an obvious modification to the flue gas tube to maximise heat transfer. Having carefully considered both arguments I find myself in agreement with the requester that D1 teaches the required path shapes with regard to the natural gas pipe and thus it would be obvious to the skilled addressee to modify the flue gas tube to increase heat transfer. Therefore I consider claims 11-13 to be obvious.

36. D1 does not disclose the flue gas tube located within the evaporator drum as being tapered in the direction from its inlet to its outlet as required by claim 14. The observer explains that the tapered heat source tube acts to increase the heat transfer coefficient while reducing the surface area of the tube. The reduced surface area means that less heat transfer fluid is required and so the system has lower thermal mass. The requester contends that the features of clam 14 are a simple workshop modification and thus claim 14 is obvious. I do not agree. Neither D1 nor D2 discloses tapered heat source tubes and I have no evidence before me to

suggest that a skilled addressee would consider it obvious to modify the flue gas tube in D1 to be tapered as required by claim 14. Therefore I consider claim 14 to be novel and inventive over D1 and D2.

37. Claim 17 requires the heater to include a fan, pump or blower. The first paragraph of 2.1 in D1 describes the present heater as not including a fan. Further the paragraph preceding 2.1 explains how an important requirement of the project is the electric autonomy of the system, i.e. no motor or fans are allowed. I agree with the observer that this is a strong teaching away from the use of fans to raise hot gas velocity and the skilled addressee would instead look to optimise the design in other ways. Therefore I consider claim 17 to be novel and inventive over D1 and D2.

38. In claim 18 the control system is configured to control the burner based on achieving a required set point temperature of the natural gas. The observer states that there is no disclosure of these features in D1 and that the passage referred to by the requester in the initial request (the last sentence of the first paragraph of section 1) merely indicates that the city-gate station demands heating systems in order to guarantee an acceptable delivery gas temperature range. In reply the requester notes that claim 18 does not say that the temperature of the natural gas to be achieved is to be measured at any point. As long as the burner is controlled such that the natural gas, at some point, is at a desired temperature, then it falls within the scope of the claim. The discussion in section 3.1 is concerned with achieving such a temperature by controlling the burners. I agree with the argument put forward by the requester and consider D1 to anticipate claim 18. The control system in D1 controls the burner to operate at one of three levels in order to heat the natural gas to a desired temperature.

Conclusion

39. I conclude that claims 1-6, 8, 10, 16 and 18 are anticipated by and claims 7, 9, 11-13 and 15 are obvious in light of D1. However in my opinion claims 14 and 17 are both novel and inventive over D1 and D2.

Application for review

40. Under section 74B and rule 98, the proprietor may, within three months of the date of issue of this opinion, apply to the comptroller for a review of the opinion.

Mr Marc Collins
Examiner

NOTE

This opinion is not based on the outcome of fully litigated proceedings. Rather, it is based on whatever material the persons requesting the opinion and filing observations have chosen to put before the Office.