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Datasheet for the decision of 12 October 2023

Case Number: T 0375/20 - 3.2.06

Application Number: 07112983.7

Publication Number: 1884628

IPC: F01D25/08, F01D9/06, F01D5/08

Language of the proceedings: EN

Title of invention:
Heat transfer system and method for turbine engine using heat pipes

Patent Proprietor:
GENERAL ELECTRIC COMPANY

Opponent:
United Technologies Corporation

Headword:

Relevant legal provisions:
EPC Art. 100(c), 123(2), 84

Keyword:
Grounds for opposition - main request - extension of subject-matter (yes)
Amendments - auxiliary requests 1 and 3-8 - allowable (no)
Claims - clarity - auxiliary request 2 (no)

Decisions cited:

Catchword:

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Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 0375/20 - 3.2.06

D E C I S I O N
of Technical Board of Appeal 3.2.06
of 12 October 2023

Appellant: (Patent Proprietor)	GENERAL ELECTRIC COMPANY 1 River Road Schenectady, NY 12345 (US)
Representative:	Grünecker Patent- und Rechtsanwälte PartG mbB Leopoldstraße 4 80802 München (DE)
Appellant: (Opponent)	United Technologies Corporation Pratt & Whitney 400 Main Street East Hartford CT 06118 (US)
Representative:	Dehns St. Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 3 December 2019 concerning maintenance of the European Patent No. 1884628 in amended form.**

Composition of the Board:

Chairman	M. Harrison
Members:	P. Cipriano
	J. Hoppe

Summary of Facts and Submissions

I. An appeal was filed by each of the appellant (opponent) and the appellant (patent proprietor) against the interlocutory decision of the opposition division in which it found that European patent No. 1 884 628 in an amended form met the requirements of the EPC.

II. In the written procedure, both parties requested that the decision under appeal be set aside, the opponent additionally that the patent be revoked, and the proprietor additionally that the patent be maintained as granted or in amended form according to one of eight auxiliary requests.

III. The Board issued a summons to oral proceedings and a subsequent communication containing its provisional opinion, in which it indicated *inter alia* that the ground for opposition under Article 100(c) EPC was considered as being prejudicial to maintenance of the patent as granted and that the amendments to claim 1 of auxiliary requests 1 and 3-7 did not fulfil the requirement of Article 123(2) EPC. The Board also indicated that it might require discussion whether the term "staggered" in claim 1 of auxiliary request 2 was clear.

IV. Oral proceedings were held before the Board on 12 October 2023, during which the opponent withdrew its objection regarding the feature "uninsulated circumferential segment" of claim 1 and the patent proprietor reordered the auxiliary requests, making auxiliary request 8 the third auxiliary request to be assessed.

At the end of the oral proceedings, the requests of the parties were as follows:

- The appellant (patent proprietor) requested that the decision under appeal be set aside and the patent be maintained as granted (main request) or as an auxiliary measure that the patent be maintained in amended form based on auxiliary request 1, i.e. that the opponent's appeal be dismissed, or that the patent be maintained in amended form based on auxiliary request 2 or on auxiliary request 8, or based on one of auxiliary requests 3 to 7 in the given order, all auxiliary requests having been filed with the grounds of appeal.

- The appellant (opponent) requested that the decision under appeal be set aside and the European patent be revoked.

V. Claim 1 of the main request reads as follows:
"A heat transfer system for a turbine engine including an annular casing (10) with an array of generally radially-extending strut members disposed therein, the heat transfer system comprising:

a plurality of arcuate heat pipes (36) disposed in contact with an outer surface (38) of the casing (10) and thermally coupled to a heat source, such that heat from the heat source can be transferred through the heat pipe and the casing (10) to the strut members; **characterized in that:**

each of the plurality of arcuate heat pipes (36) comprises an uninsulated circumferential segment, each of the plurality of heat pipes (36) having a different circumferential extent such that any given portion of

the circumferential extent of the casing (10) is in contact with no more than one of the uninsulated segments."

The wording of claim 1 of auxiliary requests 1 to 8 is appended at the end of the decision.

VI. The opponent's arguments relevant to the decision may be summarised as follows:

Main request - Article 100(c) EPC

The ground for opposition under Article 100(c) EPC prejudiced maintenance of the patent as granted.

Claim 1 omitted the feature "the plurality of heat pipes (38) are disposed [in contact with the outer surface of the casing (10)] within **fore-and-aft limits** of the axial extent of the strut member (38)" (hereinafter also referred to as feature a)) as defined in claim 5 of the application as filed, which was the basis given for the amendment. All the embodiments of the application defined the heat pipes as being within fore-and-aft limits of the axial extent of the strut members.

Auxiliary request 1 - Article 123(2) EPC

Auxiliary request 1 was not allowable since the amendments to claim 1 of auxiliary request 1 did not overcome the previous objection regarding feature a).

Auxiliary request 2 - Article 84 EPC

The term "staggered" was not clear in the context used in the claim. The term was not explained in the

description at all and the structural relationship of the pipes to each other due to staggering was not defined. In this regard it was also not clear what the difference between "staggered" and the described "stacked" arrangement was.

Auxiliary requests 3 to 7 - Article 123(2) EPC

None of the amendments made to claim 1 of auxiliary requests 3 to 7 overcame the objections under Article 123(2) EPC to the main request and auxiliary request 8.

Claim 1 of auxiliary request 6 omitted the feature "the position of the uninsulated segments of the heat pipes being **staggered**"(hereinafter also referred to as feature b)) as defined in originally filed claim 6, which was the basis given for the amendment.

Claim 1 of auxiliary request 6 further omitted the feature "a given portion of the circumferential extent of the casing (10) is in **direct** contact with essentially no more than one of the uninsulated segments (36A)" (hereinafter also referred to as feature c)) as defined in originally filed claim 6, which was the basis given for the amendment.

VII. The proprietor's arguments relevant to the decision may be summarised as follows:

Main request - Article 100(c) EPC

The ground for opposition under Article 100(c) EPC did not prejudice maintenance of the patent as granted.

Regarding feature a), in claim 1 as filed the heat pipes had not been defined as being within the fore-and-aft limits of the axial extent of the strut members and paragraphs [0011] and [0012] and [0014] of the application stated that the invention was not limited to these either.

In addition, the position of the heat pipes within the fore-and-aft limits of the axial extent of the strut members improved the heat distribution in the axial direction and was therefore not functionally linked to other features of claim 1, which improved the heat transfer in the circumferential direction.

The skilled person also recognized that the heat pipes might also not fit within the fore-and-aft limits of the axial extent of the strut members, since the turbine could be of small dimensions.

Auxiliary request 2 - Article 84 EPC

The term "staggered" was explained by the functional features of claim 6 as originally filed, i.e. meaning that a given portion of the circumferential extent of the casing (10) was in direct contact with essentially no more than one of the uninsulated segments. The two examples used by the appellant and illustrated on the flip chart during the oral proceedings both had an element of circumferential staggering.

If the Board did not agree with this definition, the term "staggered" could instead be considered non-limiting.

Auxiliary request 8 - Article 123(2) EPC

Claim 1 of auxiliary request 8 fulfilled the requirement of Article 123(2) EPC.

The term "such that" should be read as an "and" in the wording of claim 1.

There was no connection between the different circumferential extent of the heat pipes and the direct contact of the uninsulated segments with the casing. Paragraph [0021] of the application as filed provided a basis for this interpretation.

Each heat pipe of the pairs of heat pipes (with the same length) had a different circumferential extent, and claim 1 could be read as encompassing only half of the casing such that the skilled person directly and unambiguously derived that paragraph [0021] did not belong specifically to the embodiment of Figure 4, i.e. it was not necessary to define the pairs of heat pipes in claim 1.

Auxiliary request 6 - Article 123(2) EPC

Regarding feature b), an embodiment without feature b) was already covered by claim 1 as originally filed. It was clear to the skilled person when studying the application as filed that there needed to be an uninsulated heat pipe segment such that heat transfer could actually occur and nothing else. Further, the term "staggered" was not even mentioned in the description" so would not be understood as limiting.

Regarding feature c), the concept of heat transfer was already included in claim 1 as originally filed and was based on thermal conductivity of the participating elements, i.e. the skilled person knew that no direct contact was necessary.

Reasons for the Decision

1. Main request - Article 100(c) EPC

Feature a)

1.1 Claim 1 of the main request included an amendment defining, *inter alia*, a plurality of arcuate heat pipes (36) (instead of at least one arcuate heat pipe) disposed in contact with an outer surface (38) of the casing.

1.2 However, the application as filed only provides a basis for a plurality of arcuate heat pipes being disposed in contact with the outer surface (38) of the casing within fore-and-aft limits of the axial extent of the strut member, as defined in claim 5 as originally filed.

1.3 The proprietor argued that claim 1 as originally filed was not limited by the fore-and-aft limits of the axial extent of the strut members so that the feature did not need to be included from claim 5, and that paragraphs [0012], [0013] and [0015] of the patent stated that the invention was not limited to these either, and could be applied to any low pressure stage.

The Board does not find these arguments persuasive.

First, merely because claim 1 as filed is broader in scope than current claim 1, and thus originally covered embodiments without such a limitation, has no relevance as to whether there is a disclosure of a heat transfer system according to present claim 1 which is limited to features which come from claim 5.
When limitations to a filed claim are introduced, the issue to be assessed is whether there is a basis in the application as filed for those limiting features together with those in claim 1 as filed, without further features needing to be added. In the present case, the limiting features come from claim 5 as originally filed, which also includes the limitation that the heat pipes are disposed "within the fore-and-aft limits of the axial extent of the strut member". A broader disclosure is not present in claim 5.

Turning to paragraphs [0011] and [0012] of the published application (which correspond to paragraphs [0012] and [0013] of the patent specification cited by the proprietor), these also do not provide a basis for the omission of the fore-and-aft location feature. These paragraphs, in the passages considered relevant by the proprietor, merely state that the heat transfer system could be applied to all types of generally radially extending "strut members", i.e. they do not apply to any type of member other than strut members. No reference is made in these paragraphs to any possibly different arrangement of the heat pipes and the paragraphs themselves are anyway essentially limited to outlet guide vanes (OGV) strut type structures. In regard to the proprietor's further reference to paragraph [0015] of the application as filed, this simply confirms the position of the heat pipes as being within forward and aft limits.

The skilled person reading paragraphs [0011] and [0012] would only consider that there are different types of strut members than OGVs, as the paragraphs do not disclose anything regarding the location of the heat pipes in relation to the strut. Nothing different can be gleaned from paragraph [0015] in this regard either.

1.4 The proprietor also argued that the skilled person would recognise that the provision of more than one heat pipe improved the heat transfer in the circumferential direction, while their location within the fore-and-aft limits of the axial extent of the strut members improved the heat distribution in the axial direction. The two features were therefore allegedly not functionally linked. Dependent claim 2, which claimed only the disposition of a heat pipe within the fore-and-aft limits of the axial extent of the strut members alone, also provided a hint to the skilled person that the features had different effects.

The Board does not accept these arguments. The patent does not disclose anywhere that the heat pipes might be outside the fore-and-aft limits, nor that a separate advantage could be achieved when the heat pipes are preferably placed within the fore-and-aft limits of the axial extent of the strut members. On the contrary, the application as filed always (and only) discloses the heat pipes within the fore-and-aft limits of the axial extent of the strut members, regardless of the type (see e.g. [0015]). Nowhere is it stated that this position is somehow optional or only specific to some embodiments.

Claim 2 also does not provide the skilled person with any indication that the position of the heat pipes is simply optional. Claims are statements defining the

matter for which protection is sought. Claim 2 as filed refers only to claim 1 and does not belong to a chain of dependency containing originally filed claims 5 and 6 (i.e. the basis for the other features of claim 1 of the main request) and therefore does not provide a hint at the specific combination of features of claim 1 under consideration. Claim 2 as originally filed in fact defines different, more generic subject-matter comprising a single heat pipe instead of a plurality. The Board therefore fails to see how the skilled person would see dependent claim 2 as hinting that a plurality of arcuate pipes could be located differently, let alone providing an unambiguous disclosure of such an arrangement.

1.5 The proprietor also argued that the skilled person would have realised that it was not always possible to have the plurality of heat pipes within the fore-and-aft limits of the axial extent of the strut members since the dimensions of the turbine engine may be too small, as could be seen in Figure 2 of the application.

The Board does not accept this argument either. The application as filed does not deal with the dimensions of any component of the turbine engine or the heat transfer system or any associated problems. Heat pipes can be made in a variety of sizes, including sizes suitable for large and small turbine engines, and any hypothetical limitation on their implementation would be particular to specific turbine engines or their conditions of use, none of which are described in the application as filed.

1.6 Since there is no basis for feature a), the ground for opposition under Article 100(c) EPC prejudices

maintenance of the patent as granted. The main request is therefore not allowable.

2. Auxiliary request 1 - Article 123(2) EPC

2.1 The amendments to claim 1 of auxiliary request 1 (the addition of features b) and c)) do not include the introduction of feature a). The proprietor did not argue that any of the other amendments made to claim 1 of auxiliary request 1 overcame the objection discussed under point 1 and the Board cannot see that this is the case either.

2.2 Claim 1 of auxiliary request 1 does not fulfil the requirement of Article 123(2) EPC for the reasons given above for claim 1 of the main request. Auxiliary request 1 is therefore also not allowable.

3. Auxiliary request 2 - Article 84 EPC

3.1 Claim 1 of auxiliary request 2 defines *inter alia that* each of the plurality of heat pipes (36) has a different circumferential extent and the position of the uninsulated segments of the heat pipes (36) is "staggered such that any given portion of the circumferential extent of the casing (10) is in direct contact with no more than one of the uninsulated segments".

3.2 The term "staggered [uninsulated segments]" has no clear technical meaning in the context of the claim. The term "staggered" implies a lack of alignment in a particular direction yet no direction is explicitly or implicitly defined in claim 1. The term "staggered" is also not present in the description (where instead the term "stacked" is used to describe a particular

arrangement of radially spaced apart pipes), such that even if reference to the description were made, this would be of no assistance. Thus the skilled person is unable to ascertain from the claim where the uninsulated segments of the pipes must actually be located to be understood as being "staggered". The claim thus lacks clarity.

3.3 The proprietor argued that the term "staggered" was explained in the claim itself by the functional feature "such that any given portion of the circumferential extent of the casing (10) is in direct contact with no more than one of the uninsulated segments" that followed it. The direct contact should then also exclude the uninsulated segments from being radially staggered.

The Board is not persuaded by these arguments. It has not been contested that this functional feature defines that there is no overlap between the plurality of uninsulated segments in the circumferential direction. Even if an arrangement in the radial direction were excluded (a decision on which is not required), this lack of overlap can occur with the uninsulated segments being arranged in several ways (two of which were drawn by the opponent on the flip chart during the oral proceedings) where e.g. several uninsulated segments were arranged in a purely circumferential line of the casing (and thus staggered circumferentially) or offset (e.g. sequentially) in the axial direction of the casing. However, and without further qualification, it is not clear for the skilled person in which of these non-overlapping arrangements the uninsulated segments would necessarily be considered as staggered and, if both depicted examples would be considered staggered, to which of them the claim should be referring.

In addition, this would also depend on the particular direction of arrangement or the number of uninsulated segments present. For example, the appellant's indication of only two uninsulated segments covering only a small fraction of the circumferential extent might well not be considered staggered by the skilled person, such that it is not clear how many segments and/or what percentage of the circumferential extent would need to be covered for the uninsulated segments to be considered "staggered" in the context of the claim. Staggered is therefore a vague term. For the same reason, the proprietor's argument that the two examples used by the opponent and illustrated on the flip chart both had an element of circumferential staggering, such that staggering would always be understood as referring simply to a circumferential offset, also fails as this is insufficient to necessarily establish a "staggered" arrangement.

3.4 The proprietor also argued that the added term "staggered" could be considered simply as non-limiting. But, as explained in the previous paragraph, there are positions of the uninsulated segments of the heat pipes, as defined by the functional feature, which may be considered as staggered and others which may well not be. The term "staggered" therefore does limit the claim, but in a manner which is not clear.

3.5 Claim 1 of auxiliary request 2 therefore does not fulfil the requirements of Article 84 EPC such that auxiliary request 2 is not allowable.

4. Auxiliary request 8 - Article 123(2) EPC

4.1 Claim 1 of auxiliary request 8 differs from claim 1 of the main request in that features a) and c) have been added.

4.2 There is, however, no basis in the application as filed for heat pipes each including an uninsulated segment without those segments being limited to a "staggered" arrangement (feature b)) as defined in originally filed claim 6, from where the feature relating to the arrangement of pipes is taken.

Claim 1 of auxiliary request 8 defines that it is the different circumferential extent of each of the plurality of heat pipes that leads to any given portion of the circumferential extent of the casing (10) being in direct contact with no more than one of the uninsulated segments, whereas in originally filed claim 6 this was only disclosed as being a result of the position of the uninsulated segments of the heat pipes (36) being staggered.

4.3 The proprietor argued that "such that" in the wording of claim 1 should be read as "and" and that there was no connection between the different circumferential extent of the heat pipes and the direct contact of the uninsulated segments with the casing. This interpretation allegedly had a basis in paragraph [0021] of the application as filed, where the direct contact of the uninsulated portions of the heat pipes was described without the heat pipes being of different circumferential extent.

The Board is not persuaded by these arguments. Paragraph [0021] is part of to the description of the specific embodiment of Figure 4 which spans at least paragraphs [0019] to [0022]. This embodiment defines a different arrangement of heat pipes which does not correspond to the one of claim 1, since it describes pairs of heat pipes having the same length whereas claim 1 defines that each of the plurality of heat pipes (36) has a different circumferential extent. Paragraph [0021] therefore does not provide a basis for either the amendment or for the interpretation of the claim suggested by the proprietor.

4.4 The proprietor further argued that the claim wording did not exclude the possibility of considering only one half of the casing. Furthermore, the skilled person would have understood that the circumferential extent implied not only the length but also the direction of the heat pipes, i.e. there were two heat pipes of the same length but each with a different circumferential extent, one extending in a positive (e.g. clockwise) direction and the other in a negative (e.g counterclockwise) direction.

These arguments are, however, not persuasive. Claim 1 defines a heat transfer system including an annular casing and the Board does not see any particular wording of the claim that would allow the skilled person to consider one half of the annular casing as sufficient to be considered an annular casing according to claim 1.

The skilled person reading the description would also not consider that heat pipes of the same length would have different circumferential extents. Paragraphs [0019] to [0021] disclose that the heat pipes extend

from each side of a vertical centerline C, but do not specify a direction for the extension of the heat pipes. From the passages quoted by the proprietor (e.g. "Each pair of heat pipes 36 extends approximately 30° farther than the previous pair" in paragraph [0021]) it can only be concluded that the extension corresponds to an angle around the circumference of the annular fan casing.

4.5 Since claim 1 of auxiliary request 8 does not fulfil the requirements of Article 123(2) EPC, auxiliary request 8 is not allowable.

5. Auxiliary requests 3 to 7 - Article 123(2) EPC

5.1 During the oral proceedings, the proprietor did not wish to present any further arguments in respect of auxiliary requests 3 to 7 and referred only to its written submissions. The Board therefore sees no reason to alter its provisional opinion, which is hereby confirmed. This is explained below.

5.2 As stated in point 7.1 of the Board's preliminary opinion, the amendments made in claim 1 of auxiliary requests 3 to 7 define combinations of features which do not fulfil the requirement of Article 123(2) EPC for the reasons set out by the opponent in items 27, 32, 37, 42 and 47 of the opponent's reply to the proprietor's statement of grounds of appeal. In particular:

5.2.1 Paragraph [0015] of the published application, which provides the alleged basis for the amendments to claim 1 of auxiliary request 3, relates to a specific embodiment including various other features to which it is functionally related. For example, the exterior of

the casing includes a heat exchanger mounted on the outside thereof (paragraph 0014, first sentence), as well as specific types of heat pipe (see paragraphs [0016]-[0018]). Claim 1 of auxiliary request 3 does not fulfil the requirement of Article 123(2) EPC.

5.2.2 None of the amendments made to claim 1 of auxiliary requests 4 and 5 (which, according to the proprietor, had a basis in originally filed claim 6 and paragraph [0021], respectively) overcome this objection. Claim 1 of each of auxiliary requests 4 and 5 does not fulfil the requirement of Article 123(2) EPC.

5.2.3 Claim 1 of auxiliary request 6 is a combination of claim 1 of the main request with feature a) but without features b) and c).

(a) As mentioned by the Board in items 1.2 to 1.2.2 of its preliminary opinion, there is no basis in the application as filed for heat pipes each including an uninsulated segment without these segments being staggered and in direct contact (features b) and c)) with a given portion of the circumferential extent of the casing as defined in originally filed claim 6.

(b) Although the term "staggered" is not mentioned in the description, it is limiting in the sense that it implies a certain positional relationship of the uninsulated segments (see the foregoing reasoning above in items 3.3 and 3.4). There is thus no basis for including the position of the uninsulated segments without these being "staggered". Its omission is therefore regarded as resulting in an unallowable intermediate generalisation.

(c) Similarly, there is no basis for a given portion of the circumferential extent of the casing to be in contact with no more than one of the uninsulated segments without the contact being *direct* contact. The type of contact (direct) is structurally and functionally linked to the heat transferring function between the uninsulated portions of the heat pipes and the outer surface of the casing and no other type of contact is disclosed. Although the skilled person knows that heat transfer can occur with other arrangements, no such arrangements are disclosed in the application as filed. Merely because a skilled person may know from their general knowledge that other non-contacting arrangements might be possible, does not imply that these are disclosed, let alone unambiguously in the context of the invention defined in claim 1.

5.2.4 Claim 1 of auxiliary request 7 is a combination of the features of claim 1 of the main request with feature c) but without features a) and b). Thus, claim 1 of auxiliary request 7 does not fulfil the requirement of Article 123(2) EPC for the reasons stated above in items 1 and 2.1.

5.3 None of auxiliary requests 3 to 7 is consequently allowable.

6. In the absence of any request which meets the requirements of the EPC, the patent must be revoked.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

D. Grundner M. Harrison

Decision electronically authenticated

Claim 1 according to Auxiliary request 1

1. A heat transfer system for a turbine engine including an annular casing (10) with an array of generally radially-extending strut members disposed therein, the heat transfer system comprising:

a plurality of arcuate heat pipes (36) disposed in contact with an outer surface (38) of the casing (10) and thermally coupled to a heat source, such that heat from the heat source can be transferred through the heat pipe and the casing (10) to the strut members;

~~**characterized in that:**~~wherein

each of the plurality of arcuate heat pipes (36) comprises an uninsulated circumferential segment, each of the plurality of heat pipes (36) having a different circumferential extent and the position of the uninsulated segments of the heat pipes (36) being staggered such that any given portion of the circumferential extent of the casing (10) is in direct contact with no more than one of the uninsulated segments.

Claim 1 of auxiliary request 2

1. A heat transfer system for a turbine engine including an annular casing (10) with an array of generally radially-extending strut members disposed therein, the heat transfer system comprising:

a plurality of arcuate heat pipes (36) disposed in contact with an outer surface (38) of the casing (10) within fore-and-aft limits of the axial extent of the strut members and thermally coupled to a heat source, such that heat from the heat source can be transferred through the heat pipe and the casing (10) to the strut members;

~~**characterized in that:**~~wherein

each of the plurality of arcuate heat pipes (36) comprises an uninsulated circumferential segment, each of the plurality of heat pipes (36) having a different circumferential extent and the position of the uninsulated segments of the heat pipes (36) being staggered such that any given portion of the circumferential extent of the casing (10) is in direct contact with no more than one of the uninsulated segments.

Claim 1 of auxiliary request 8

1. A heat transfer system for a turbine engine including an annular casing (10) with an array of generally radially-extending strut members disposed therein, the heat transfer system comprising:

a plurality of arcuate heat pipes (36) disposed in contact with an outer surface (38) of the casing (10) within fore-and-aft limits of the axial extent of the strut members and thermally coupled to a heat source, such that heat from the heat source can be transferred through the heat pipe and the casing (10) to the strut members;

~~**characterized in that:**~~wherein

each of the plurality of arcuate heat pipes (36) comprises an uninsulated circumferential segment, each of the plurality of heat pipes (36) having a different circumferential extent such that any given portion of the circumferential extent of the casing (10) is in direct contact with no more than one of the uninsulated segments.

Claim 1 of auxiliary request 3

1. A heat transfer system for a turbine engine including an annular casing (10) with an array of generally radially-extending strut members disposed therein, the heat transfer system comprising:

a plurality of arcuate heat pipes (36) disposed around the exterior of the casing (10) in contact with an outer surface (38) of the casing (10) and positioned within fore-and-aft limits of the axial extent of the strut members and thermally coupled to a heat source, such that heat from the heat source can be transferred through the heat pipe and the casing (10) to the strut members;

~~**characterized in that:**~~wherein

each of the plurality of arcuate heat pipes (36) comprises an uninsulated circumferential segment, each of the plurality of heat pipes (36) having a different circumferential extent and the position of the uninsulated segments of the heat pipes (36) being staggered such that any given portion of the circumferential extent of the casing (10) is in direct contact with no more than one of the uninsulated segments.

Claim 1 of auxiliary request 4

1. A heat transfer system for a turbine engine including an annular casing (10) with an array of generally radially-extending strut members disposed therein, the heat transfer system comprising:

a plurality of arcuate heat pipes (36) disposed around the exterior of the casing (10) in contact with an outer surface (38) of the casing (10) and positioned within fore-and-aft limits of the axial extent of the strut members and thermally coupled to a heat source, such that heat from the heat source can be transferred through the heat pipe and the casing (10) to the strut members;

~~characterized in that:~~wherein

each of the plurality of arcuate heat pipes (36) comprises an uninsulated circumferential segment, each of the plurality of heat pipes (36) having a different circumferential extent and the position of the uninsulated segments of the heat pipes (36) being staggered such that any given portion of the circumferential extent of the casing (10) is in direct contact with no more than one of the uninsulated segments,

wherein each heat pipe (36) includes a first end (44) connected to a heat exchanger (28), the uninsulated segment (36A) disposed at a distal end of the heat pipe (36), and an insulated portion disposed between the first end (44) and the uninsulated segment (36A).

Claim 1 of auxiliary request 5

1. A heat transfer system for a turbine engine including an annular casing (10) with an array of generally radially-extending strut members disposed therein, the heat transfer system comprising:

a plurality of arcuate heat pipes (36) disposed around the exterior of the casing (10) in contact with an outer surface (38) of the casing (10) and positioned within fore-and-aft limits of the axial extent of the strut members and thermally coupled to a heat source, such that heat from the heat source can be transferred through the heat pipe and the casing (10) to the strut members;

~~characterized in that:~~wherein

each of the plurality of arcuate heat pipes (36) comprises an uninsulated circumferential segment, each of the plurality of heat pipes (36) having a different circumferential extent and the position of the uninsulated segments of the heat pipes (36) being staggered such that any given portion of the circumferential extent of the casing (10) is in direct contact with no more than one of the uninsulated segments,

wherein each heat pipe (36) includes a first end (44) connected to a heat exchanger (28), the uninsulated segment (36A) disposed at a distal end of the heat pipe (36), and an insulated portion disposed between the first end (44) and the uninsulated segment (36A),

wherein the heat pipes (36) are insulated in such a manner that heat can be transferred a substantial distance around the periphery of the casing (10), and wherein the pattern of uninsulated segments provides substantially 360° coverage of the casing (10).

Claim 1 of auxiliary request 6

1. A heat transfer system for a turbine engine including an annular casing (10) with an array of generally radially-extending strut members disposed therein, the heat transfer system comprising:

a plurality of arcuate heat pipes (36) disposed in contact with an outer surface (38) of the casing (10) within fore-and-aft limits of the axial extent of the strut members and thermally coupled to a heat source, such that heat from the heat source can be transferred through the heat pipe and the casing (10) to the strut members;

~~**characterized in that:**~~wherein

each of the plurality of arcuate heat pipes (36) comprises an uninsulated circumferential segment, each of the plurality of heat pipes (36) having a different circumferential extent such that any given portion of the circumferential extent of the casing (10) is in contact with no more than one of the uninsulated segments.

Claim 1 of auxiliary request 7

1. A heat transfer system for a turbine engine including an annular casing (10) with an array of generally radially-extending strut members disposed therein, the heat transfer system comprising:

a plurality of arcuate heat pipes (36) disposed in contact with an outer surface (38) of the casing (10) and thermally coupled to a heat source, such that heat from the heat source can be transferred through the heat pipe and the casing (10) to the strut members;

~~**characterized in that:**~~wherein

each of the plurality of arcuate heat pipes (36) comprises an uninsulated circumferential segment, each of the plurality of heat pipes (36) having a different circumferential extent such that any given portion of the circumferential extent of the casing (10) is in direct contact with no more than one of the uninsulated segments.

2. The heat transfer system of claim 1, wherein the at least one heat pipe (36) is disposed within fore-and-aft limits of the axial extent of the strut members.