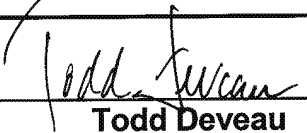


Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
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4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a) FY 2005 <i>(Fees pursuant to the Consolidated Appropriations act, 2005 (H.R. 4818).)</i>		Docket No. 821920-1030	
Application Number: 10/937,736		Filed: 09/08/2004	
For: Refrigerant with Lubricating Oil for Replacement of R22 Refrigerant			
Art Unit: 1751		Examiner: Hardee	
This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.			
The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):			
		<u>Fees</u>	<u>Small Entity</u>
			<u>Fees</u>
☐	One month (37 CFR 1.17(a)(1))	\$120	\$60
☒	Two months (37 CFR 1.17(a)(2))	\$450	\$225 \$225
☐	Three months (37 CFR 1.17(a)(3))	\$1020	\$510
☐	Four months (37 CFR 1.17(a)(4))	\$1590	\$795
☐	Five months (37 CFR 1.17(a)(5))	\$2160	\$1080
☒ Applicant claims small entity status. See 37 CFR 1.27			
☐ A check in the amount of the fee is enclosed.			
☐ Payment by credit card. Form PTO-2038 is attached.			
☒ The Director has already been authorized to charge fees in this application to a Deposit Account.			
☒ The Commissioner is hereby authorized to charge any deficiencies in fees which may be required, or credit any overpayment to Deposit Account No. 20-0778.			
WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.			
I am the			
☐ applicant/inventor.			
☐ assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed (Form PTO/SB/96).			
☒ attorney or agent of record. Registration Number: 29,526			
☐ attorney or agent under 37 CFR 1.34. Registration number if acting under 37 CFR 1.34:			
 Todd Deveau		08/13/2007 Date 770-933-9500 Telephone Number	

The collection of information is required by CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 USC 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, US Patent and Trademark Office, US Department of Commerce, PO Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, PO Box 1450 Alexandria, VA 22313-1450.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Docket No.: 821920-1030

PONDER, K., et al.,

Art Unit: 1751

Serial No.: 10/937,736

Examiner: John R. Hardee

Filing Date: September 8, 2004

Confirmation No.: 1006

For: **Refrigerant with Lubricating Oil for Replacement of R-22 Refrigerant**

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

Please consider this Preliminary Amendment prior to further examination of this application pursuant to Applicant's Request for Continued Examination filed concurrently herewith. The Final Office Action, Paper No./Mail Date 20061207, from Examiner John R. Hardee of Art Unit 1751, mailed December 11, 2006, has been received and carefully reviewed. Applicants respectfully request reconsideration and withdrawal of the rejections presented in the Office Action in view of the following remarks and amendment. No new matter and, thus, no new issues are presented.

AUTHORIZATION TO DEBIT ACCOUNT

It is not believed that any extensions of time or fees are required, beyond those which may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 C.F.R. § 1.136(a), and any fees required therefor (including fees for net addition of claims) are hereby authorized to be charged to deposit account no. 20-0778.

IN THE SPECIFICATION

Page 13, line 12, delete the paragraphs beginning with “Fig. 1 shows...” and ending on line 15 with “...pentafluoroethane to R-22.” and replace them with the following paragraphs:

--Fig. 1 shows Pressure (liquid) vs. Temperature profiles for R-22 and blends of [[60/40, 55/45 and 58/42]] 40/60, 45/55 and 42/58 of tetrafluoroethane and pentafluoroethane, respectively.

Fig. 2 shows Temperature vs. Enthalpy profiles comparing a blend of [[60/40]] 40/60 tetrafluoroethane and pentafluoroethane to R-22.--

IN THE CLAIMS

Please amend the claims to read as follows wherein changes in a claim are shown by double brackets for deleted matter and underlining for added matter:

1. (Currently amended) In an apparatus designed for use with chlorodifluoromethane refrigerant, the improvement comprising substituting the chlorodifluoromethane with a [[substitute blend]] refrigerant composition containing a lubricant, the refrigerant composition comprising a combination of refrigerant gases and non-refrigerant gas components.
 - (a) said [[substitute]] refrigerant gases consisting [[essentially]] of:
about 40% to about 45% by weight tetrafluoroethane [[pentafluoroethane]]; and
about 55% to about 60% by weight; and pentafluoroethane [[tetrafluoroethane]];
 - (b) said non-refrigerant gas components including [[substitute refrigerant packaged with]] about 0.5% up to about 20% by weight of the refrigerant gases [[with]] a lubricating oil that is soluble in chlorodifluoromethane, pentafluoroethane and tetrafluoroethane,
wherein the lubricating oil is selected from the group consisting of napthenic based lubricants, paraffinic based lubricants, and mixtures thereof, mineral oil, polyol ester, synthetic alkyl aromatic lubricants, synthetic alkyl aromatic lubricants mixed with mineral oil, and synthetic alkyl aromatic lubricants mixed with polyol ester.
2. (Original) The invention according to Claim 1, the lubricating oil having the following components:
65-88% hydrotreated light napthenic distillate, and
10-20% solvent refined light napthenic distillate petroleum.
3. (Currently amended) The invention according to claim 1 wherein in the substitute refrigerant said pentafluoroethane is present in the ratio of about 60% [[40%]] by weight to said tetrafluoroethane present in an amount of about 40% [[60%]] by weight.
4. (Currently amended) The invention according to claim 1 wherein in the substitute refrigerant said pentafluoroethane is present in the ratio of about 58% [[42%]] by weight to said tetrafluoroethane present in an amount of about 42% [[58%]] by weight.

5. (Currently amended) The invention according to claim 1 wherein in the substitute refrigerant said pentafluoroethane is present in the ratio of about 55% ~~[[45%]]~~ by weight to said tetrafluoroethane present in an amount of about 45% ~~[[55%]]~~ by weight.

6. (Currently amended) A method for refilling an apparatus designed for use with a chlorodifluoromethane refrigerant, the method comprising:

(1) supplying a substitute refrigerant composition under pressure, in a cylinder can fitted with an outlet compatible with a chlorodifluoromethane recharging manifold of the apparatus; and

(2) adding to said apparatus via the manifold ~~[[a]]~~ the substitute refrigerant composition for chlorodifluoromethane, said substitute refrigerant composition ~~[[consisting essentially of:]]~~ comprising a combination of refrigerant gases and non-refrigerant gas components.

(a) the refrigerant gases consisting of:

about 40% to about 45% by weight ~~[[pentafluoroethane]]~~

tetrafluoroethane; and

about 55% to about 60% by weight ~~[[tetrafluoroethane]]~~

pentafluoroethane; and

(b) the non-refrigerant components including ~~[[said substitute refrigerant packaged with]]~~ about 0.5% up to about 20% by weight of the refrigerant gases of a lubricating oil that is soluble in chlorodifluoromethane, pentafluoroethane and tetrafluoroethane,

wherein the lubricating oil is selected from the group consisting of naphthenic based lubricants, paraffinic based lubricants, and mixtures thereof, mineral oil, polyol ester, synthetic alkyl aromatic lubricants, synthetic alkyl aromatic lubricants mixed with mineral oil, and synthetic alkyl aromatic lubricants mixed with polyol ester.

7. (Previously presented) The method according to claim 6, the lubricating oil having the following components:

65-85% hydrotreated light naphthenic distillate, and

10-20% solvent refined light naphthenic distillate petroleum.

8. (Currently amended) The method according to claim 6 wherein in the substitute refrigerant said pentafluoroethane is present in the ratio of about 60% ~~[[40%]]~~ by weight to said tetrafluoroethane present in an amount of about 40% ~~[[60%]]~~ by weight.

9. (Currently amended) The method according to claim 6 wherein in the substitute refrigerant said pentafluoroethane is present in the ratio of about 58% ~~[[42%]]~~ by weight to said tetrafluoroethane present in an amount of about 42% ~~[[58%]]~~ by weight.

10. (Currently amended) The method according to claim 6 wherein in the substitute refrigerant said pentafluoroethane is present in the ratio of about 55% ~~[[45%]]~~ by weight to said tetrafluoroethane present in an amount of about 45% ~~[[55%]]~~ by weight.

11. – 20. (Cancelled)

21. (Currently amended) A refrigerant composition comprising a combination of refrigerant gases and non-refrigerant gas components, [[consisting essentially of:]]

(a) the refrigerant gases consisting of:

about 40% to about 45% by weight ~~[[pentafluoroethane]]~~

tetrafluoroethane; and

about 55% to about 60% by weight ~~[[tetrafluoroethane]]~~

pentafluoroethane; and

(b) the non-refrigerant gas components including ~~[[said refrigerant packaged with]]~~ about 0.5% up to about 20% by weight of the refrigerant gases of a lubricating oil ~~[[that is soluble in chlorodifluoromethane, pentafluoroethane and tetrafluoroethane]]~~.

wherein the lubricating oil is selected from the group consisting of naphthenic based lubricants, paraffinic based lubricants, and mixtures thereof, mineral oil, polyol ester, synthetic alkyl aromatic lubricants, synthetic alkyl aromatic lubricants mixed with mineral oil, and synthetic alkyl aromatic lubricants mixed with polyol ester.

22. (Original) The invention according to claim 21, the lubricating oil having the following components:

65-85% hydrotreated light naphthenic distillate, and

10-20% solvent refined light napthenic distillate petroleum.

23. (Currently amended) A refrigerant according to claim 21 wherein said pentafluoroethane is present in the ratio of about 60% ~~[[40%]]~~ by weight to said tetrafluoroethane present in an amount of about 40% ~~[[60%]]~~ by weight.

24. (Currently amended) A refrigerant according to claim 21 wherein said pentafluoroethane is present in the ratio of about 55% ~~[[45%]]~~ by weight to said tetrafluoroethane present in an amount of about 45% ~~[[55%]]~~ by weight with a napthenic lubricant.

25. (Currently amended) A refrigerant according to claim 21 wherein said pentafluoroethane is present in the ratio of about 58% ~~[[40%]]~~ by weight to said tetrafluoroethane present in an amount of about 42% ~~[[60%]]~~ by weight with a napthenic lubricant.

26. (Cancelled)

27. (Previously presented) The refrigerant according to claim 21, wherein the lubricating oil further includes an acrylic polymer or a corrosion inhibitor or both.

28. (Cancelled)

29. (Previously presented) The refrigerant according to claim 21, wherein the lubricating oil is an alkylbenzene-based lubricating oil.

30. (Previously presented) The invention according to claim 1, wherein the apparatus is selected from the group consisting of refrigeration equipment, air-conditioning equipment, and HVAC equipment.

31. (Previously presented) The invention according to claim 1, wherein the lubricating oil includes an additive selected from the group consisting of acrylic polymer, a corrosion inhibitor and mixtures thereof.

32. (Cancelled)

33. (Previously presented) The invention according to claim 1, wherein the lubricating oil is an alkylbenzene-based lubricating oil.

34. (Previously presented) The method according to claim 6, wherein the apparatus is selected from the group consisting of refrigeration equipment, air-conditioning equipment, and HVAC equipment.

35. (Previously presented) The method according to claim 6, wherein the lubricating oil includes an additive selected from the group consisting of acrylic polymer, a corrosion inhibitor and mixtures thereof.

36. (Cancelled)

37. (Previously presented) The method according to claim 6, wherein the lubricating oil is an alkylbenzene-based lubricating oil.

38. (Previously presented) The invention according to claim 1, wherein the tetrafluoroethane is 1,1,1,2-tetrafluoroethane.

39. (Previously presented) The method of claim 6, wherein the tetrafluoroethane is 1,1,1,2-tetrafluoroethane.

40. (Previously presented) The invention of claim 21, wherein the tetrafluoroethane is 1,1,1,2-tetrafluoroethane.

REMARKS

Claims 1-10, 21-25, 27, 29-31, 33-35 and 37-40 are pending in the above application.

The claims stand rejected under 35 U.S.C. 103(a) as allegedly unpatentable over Roberts (US 6,428,720).

1. The Present Claims

The claims submitted herein include independent claims 1, 6 and 21. All of the independent claims are directed to a refrigerant composition or a substitute refrigerant composition comprising a combination of refrigerant gases and non-refrigerant gas components, the refrigerant gases consisting of about 40% to about 45% by weight tetrafluoroethane, about 55% to about 60% by weight pentafluoroethane, which refrigerant gases are packaged with or include about 0.5% up to about 20% by weight with a specified lubricating oil.

2. Rejection Under Section 103(a)

The rejection under Section 103(a) is based solely on Roberts is traversed on the grounds that : 1) Roberts fails to disclose the particular combination or blend of refrigerant gases recited in independent claims 1, 6 and 21 and, in fact, teaches away from Applicant's combination of refrigerant gases, and 2) Roberts fails to teach or disclose the packaging of the lubricating oil specified in these claims with the recited combination of refrigerant gases for subsequent use in equipment, such as cooling or air conditioning equipment.

Roberts discloses a three component refrigerant composition which comprises (a) pentafluoroethane, octafluoropropane, trifluoromethoxydifluoromethane or hexafluorocyclopropane, or a mixture of two or more thereof, in an amount of at least about 35% based on the weight of the composition; (b) 1,1,1,2- or 1,1,2,2-tetrafluoroethane, 1,1-difluoroethane, trifluoromethoxypentafluoroethane, 1,1,1,2,3,3-heptafluoropropane, or a mixture of two or more thereof, in an amount of at least about 30% by weight based on the weight of the composition and (c) n-butane, in an amount from about 2.3 to about 4% by weight based on the weight of the composition. See Abstract; Col. 3, lines 1-12.

Roberts teaches that n-butane is a necessary component of his refrigerant composition. Roberts teaches: "Generally the performance of the composition deteriorates as the concentration of butane is decreased down to 2.3% by weight. Similarly, for a given butane content, the performance characteristics of the composition deteriorate as the concentration of R125 (pentafluoroethane) is increased." (Emphasis added). See Col. 3, lines 28-33. Roberts, thus, teaches that n-butane materially effects the basic and novel properties of the refrigerant composition and teaches away from eliminating or removing n-butane as the third component of his refrigerant composition.

According to the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) the presence of a small amount of n-butane refrigerant is considered to materially effect the basic and novel properties of the refrigerant composition. With respect to Roberts, ASHRAE has granted the designation R417A to Roberts' refrigerant composition comprised of 46.6% pentafluoroethane (R125), 50.0% tetrafluoroethane (R134a) and 3.4% n-butane (R600). See Addendum c, to ANSI/ASHRAE Standard 34-2001 (2003), included in Applicant's Information Disclosure Statement filed concurrently herewith. In contrast, ASHRAE has granted the designation R422D to a refrigerant blend of 65.1% pentafluoroethane (R125), 31.5% tetrafluoroethane (R134a) and 3.4% isobutane (R600a). See Addendum h to ANSI/ASHRAE Standard 34-2004 (2006), included in Applicant's Information Disclosure Statement filed concurrently herewith. ASHRAE, on the other hand, has granted the designation R421 to refrigerant compositions comprising pentafluoroethane and tetrafluoroethane without butane. (See Addendum a, b, c, e, f, k, n, o, p, q, r, s and u to ANSI/ASHRAE Standard 34-2004 (2006), included in Application" Information Disclosure Statement filed concurrently herewith. These different ASHRAE designations show that the industry recognizes that the presence or absence of a small amount of refrigerant gas such as n-butane materially affects the basic and novel properties of the refrigerant composition. If, in view of the above information, the Examiner considers that the presence of n-butane would not materially effect the basic and novel properties of Applicant's claimed refrigerant composition, Applicant respectfully requests that evidence be provided to support such position.

Moreover, Roberts does not teach packaging or including a lubricant with the refrigerant composition prior to use or installation in the equipment. Applicants respectfully take issue with the statement in the Advisory Action, Paper No./Mail Date 20070304, mailed March 6, 2007, concerning Applicants' claimed packaging of lubricant with the recited refrigerant gases prior to installation in refrigeration equipment. The Advisory Action comments that Applicants' argument on this issue is not persuasive "because the disclosed lubricants are disclosed as fully miscible with the refrigerants." Applicants respectfully submit that this characterization of Roberts is incorrect. No citation is provided in the Advisory Action, such as by column and line, to where Roberts teaches that the disclosed lubricants are "fully miscible" with the refrigerants. Applicants cannot find anywhere in Roberts where there is such a teaching. Roberts simply states that: "the compositions of the present invention are highly compatible with the mineral oil lubricants which have been conventionally used with CFC refrigerants. Accordingly, the compositions of the present invention can be used with mineral oil and alkyl benzene lubricants..." (See column 3, line 49 – column 4, line 2). This does not support the statement

that the disclosed lubricants are “fully miscible” with the refrigerants. Instead Roberts teaches the installation of his refrigerant composition without lubricant in equipment wherein the equipment is lubricated prior to the installation of the refrigerant. (See, Roberts, column 6, lines 54-57: “The equipment used consisted of Danfoss SC12BXT2 air cooled condensing unit with the original mineral oil lubricant and a sight glass fitted to the compressor shell to enable the oil level [in the compressor] to be checked.”). Thus, Roberts teaches no more than its three component refrigerant composition can be used in, for example, cooling or air conditioning equipment having such lubricants prior to the installation of the refrigerant composition in the equipment. This does not teach that a refrigerant composition packaged with or including a lubricant prior to installation in the equipment.

3. The Amendment of the specification and Claims

Applicant has amended the Specification to correctly describe the data presented in Figs. 1 and 2, consistent with the data in Table 2 on which Fig. 1 is based. The claims are also amended to conform to the data in Figs. 1 and 2 and also Table 2. Since Figs. 1 and 2 and Table 2 were presented with this application as first filed, no new matter is presented.

CONCLUSION

In view of the foregoing, favorable reconsideration and allowance of the present application and pending claims is hereby courteously requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at 770-933-9500.

The Commissioner is authorized to charge Deposit Account 20-0778 for any deficiencies or credit any over payments.

Respectfully Submitted,

**THOMAS, KAYDEN, HORSTEMEYER
& RISLEY, L.L.P.**

By /todd deveau/
Todd Deveau, Reg. No. 29,526

100 Galleria Parkway, Suite 1750
Atlanta, Georgia 30339-5948
(770) 933-9500

Docket No. 821920-1030

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)

Application Number	10937736
Filing Date	2004-09-08
First Named Inventor	Ponder, K.
Art Unit	1751
Examiner Name	Hardee, J.
Attorney Docket Number	821920-1030

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	1	WO01/23493	WO		2001-04-05	Refrigerant Products, Ltd.		☐
	2	EP1295928	EP		2003-03-26	Honeywell International, Inc.		☐

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	10937736
Filing Date	2004-09-08
First Named Inventor	Ponder, K.
Art Unit	1751
Examiner Name	Hardee, J.
Attorney Docket Number	821920-1030

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	ASHRAE Standard Designation and Safety Classification of Refrigerants, ANSI/ASHRAE Addendum c to ANSI/ASHRAE Standard 34-2001, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (2003)	☐
	2	ASHRAE Standard Designation and Safety Classification of Refrigerants, ANSI/ASHRAE Addendum h to ANSI/ASHRAE Standard 34-2004, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (2006)	☐
	3	ASHRAE Standard Designation and Safety Classification of Refrigerants, ANSI/ASHRAE Addendum d to ANSI/ASHRAE Standard 34-2001, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (2003)	☐
	4	ASHRAE Standard Designation and Safety Classification of Refrigerants, ANSI/ASHRAE Addendum e to ANSI/ASHRAE Standard 34-2001, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (2003)	☐
	5	Designation and Safety Classification of Refrigerants, ANSI/ASHRAE Addenda a, b, c, e, f, k, n, o, p, q, r, s and u to ANSI/ASHRAE Standard 34-2004, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (2006)	☐

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EXAMINER SIGNATURE

Examiner Signature	Date Considered
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¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	10937736
Filing Date	2004-09-08
First Named Inventor	Ponder, K.
Art Unit	1751
Examiner Name	Hardee, J.
Attorney Docket Number	821920-1030

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/todd deveau/	Date (YYYY-MM-DD)	2007-08-13
Name/Print	Todd Deveau	Registration Number	29526

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(54) Title: **R 22 REPLACEMENT REFRIGERANT**

(57) Abstract: A refrigerant composition comprising a hydrofluorocarbon component including 1,1,1,2-tetrafluoroethane (HCFC 134a), the composition further comprising an additive selected from a saturated hydrocarbon or mixture thereof boiling in the range -5 to +70 °C.



WO 01/23493 A1

-1-

R 22 REPLACEMENT REFRIGERANT

This invention relates to a refrigerant particularly but not exclusively for air conditioning systems. The system relates especially to refrigerant compositions which have no adverse effect on the atmospheric ozone layer and to compositions which can be added to existing refrigerants which are compatible with lubricants commonly used in refrigeration and air conditioning systems. The invention also relates to a method of modifying refrigeration and air conditioning systems.

Chlorofluorocarbons (CFCs) eg CFC 11 and CFC 12 are stable, of low toxicity and non-flammable providing low hazard working conditions used in refrigeration and air conditioning systems. When released they permeate into the stratosphere and attack the ozone layer which protects the environment from damaging effects of ultraviolet rays. The Montreal Protocol, an International environmental agreement signed by over 160 countries, mandates the phase-out of CFCs according to an agreed timetable. This now includes hydrochlorofluorocarbons (HCFCs) which also have an adverse effect on the ozone layer.

R 22 is a chemical fluid and by far the largest HCFC refrigerant used globally in refrigeration and air conditioning equipment. R 22 has an Ozone Depletion Potential (ODP) of approximately 5% of CFC 11. After CFCs have been phased out, the chlorine content of R 22 will make it the largest ozone depleting substance in volumetric terms. R 22 is also the subject of a phase-out schedule under the Montreal Protocol. R 22 is prohibited from use in new equipment in some countries.

Any replacement for HCFC 22 must have no ability to deplete ozone. The compositions of the present invention do not include chlorine atoms and consequently they will have no deleterious effect on the ozone layer while providing a similar performance as a working fluid to R 22 in refrigeration apparatus.

Various terms have been used in patent literature to describe refrigerant mixtures. These may be defined as follows:

Zeotrope: A fluid mixture whose vapour and liquid compositions are different at a specified temperature.

-2-

Temperature glide: If a zeotropic liquid is distilled at constant pressure its boiling point will increase. The change in boiling point from the beginning of the distillation until the point when a liquid phase has just disappeared is called the temperature glide. A glide is also observed when the saturated vapour of a zeotrope is condensed at constant pressure.

Azeotrope: A fluid mixture of specified composition whose vapour and liquid compositions are the same at a specified temperature. Strictly speaking a fluid mixture which is an azeotrope under for example evaporator conditions, cannot also be an azeotrope under the condenser conditions. However the refrigeration literature may describe a mixture as azeotropic provided that it meets the above definition at some temperature within its working range.

Near-azeotropes: A blend which boils over a small temperature range, that has a small temperature glide.

Retrofit refrigerant mixture: A non-chlorine-containing mixture used to replace completely the original CFC or HCFC refrigerant.

Extender refrigerant mixture: A non-chlorine-containing mixture added during servicing to the HCFC refrigerant remaining in a unit, that is a top up refrigerant to make good any leakage.

Hermetic compressor: A compressor where the electric motor is in the same totally welded casing as the compressor. The motor is cooled by the refrigerant vapour returning to the compressor. The heat generated by the motor is removed through the condenser.

Semi-hermetic compressor: Similar to a hermetic compressor, the major difference being the casing has a bolted joint which can be opened to enable the motor and compressor to be serviced.

Open compressor: A compressor which is driven by an external motor via a drive shaft passing through the compressor casing. The motor heat is dissipated directly to the environment, not via the condenser. This results in a slightly more efficient performance than a hermetic compressor, but refrigerant leaks can occur at the shaft seal.

Percentages and proportions referred to in this specification are by weight unless indicated otherwise. Percentages and proportions are selected to total 100%. HFC and HCFC refrigerant compounds are referred to below by the letter R.

-3-

According to a first aspect of the present invention a refrigerant composition comprises 1,1,1,2-tetrafluoroethane (R134a), pentafluoro ethane (R 125) and an additive selected from a saturated hydrocarbon or mixture thereof boiling in the range -5 to $+70^{\circ}\text{C}$; wherein the of weights of R 125 and R 134a are in the ranges:

R 125 50 - 80%

R 134a 50 - 20%

The compositions may be used as retrofit refrigerant mixtures. The composition may also be used as extenders as discussed below. The compositions may be used in semi-hermetic and hermetic systems.

The preferred weights of R125 to R 134a are in the ranges:

R 125 60 - 80%

R 134a 40 - 20%

A more preferred range is:

R 125 60 - 78%

R 134a 40 - 22%

A most preferred range is:

R 125 64 - 76%

R 134a 34 - 24%

These ranges are preferred for hermetic and semi-hermetic systems. The composition may also be used in an open system. The preferred weights in an open system are in the ranges:

R 125 57 - 78%

R 134a 43 - 22%.

A more preferred range is:

R 125 63 - 76%

R 134a 33 - 24%

The proportion of R 125 used in an open system may be up to 10%, preferably 4 to 5 % higher than in a hermetic or semi-hermetic system.

In a first aspect of this invention no other refrigerant may be included in the mixture. In a second aspect, suitable for use as an R 22 extender, an additional refrigerant R 32 may be added.

-4-

Preferred hydrocarbons additives are selected from the group consisting of: 2-methylpropane, 2,2-dimethylpropane, butane, pentane, 2-methylbutane, cyclopentane, hexane, 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane and methylcyclopentane. The hydrocarbon additive preferably has a boiling point in the range 20 to 40°C. Use of n-pentane, cyclopentane, iso-pentane and mixtures thereof is preferred. Use of n-pentane, isopentane or mixtures thereof is especially preferred. Commercially available saturated hydrocarbon mixtures are available from cyclopentane commercial grade from Phillips Petroleum International NV, Norpar[®] 5 S n-pentane from Exxon Chemical and iso-pentane Q1111 from Shell Chemicals.

Relative proportions of the pentane and butane components may be selected to give a total of 0.2 to 5% of the compositions, preferably 2 to 4%, more preferably 3 to 4%. An amount of pentane, preferably isopentane of 0.2 to 2% may be used together with a corresponding amount of 4.8 to 3% of butane in a composition containing a total of 5% hydrocarbon. In compositions with less than 5% hydrocarbon, for example 1% or 4%, relatively larger ratios of butane : pentane may be employed to minimise hydrocarbon build-up on leakage. Flammability risks are therefore reduced.

According to a second aspect of the present invention a refrigerant extender mixture comprises a composition in accordance with the first aspect of this invention.

According to a third aspect of this invention a refrigerant composition comprises a composition in accordance with the first aspect of this invention together with R 22. This invention also provides a method of modifying a refrigerator or air conditioning system incorporating R 22 as refrigerant, the method comprising the step of adding a composition in accordance with the second aspect of this invention to the refrigerant of the system.

Positive displacement compressors, that is reciprocating or rotary compressors, used in refrigeration systems suck in small amounts of lubricant from the crank case which are ejected with the refrigerant vapour through the exhaust valves. In order to maintain compressor lubrication this oil must be forced around the circuit by the refrigerant stream and returned to the crank case. CFC and HCFC refrigerants are miscible with hydrocarbon oils and hence carry the oils around the circuit. However HFC refrigerants and hydrocarbon lubricants have low mutual solubilities so effective oil return may not occur. The problem is particularly acute in evaporators where low temperatures can increase the

-5-

viscosities of oils sufficiently to prevent them being carried along the tube walls. With CFCs and HCFCs enough refrigerant remains in the oil to reduce the viscosities to enable oil return to occur.

When using HFCs with hydrocarbon lubricants oil return can be facilitated by introducing into the system a hydrocarbon fluid having the following properties:

- (a) sufficient solubility in the lubricant at the evaporator temperature to reduce its viscosity; and
- (b) sufficient volatility to allow distillation from the hot lubricant in the compressor crank case.

Hydrocarbons fulfil these requirements.

Refrigerant compositions in accordance with this invention confer several advantages. R 125 has fire suppressing characteristics. The presence of R125 suppresses the flammability of the refrigerant mixture. The higher HFC content enables more n-pentane to be added to the mixture thereby improving the solubility properties of the mixture with traditional lubricants, for example mineral and alkyl benzene oils.

The present invention may confer a number of benefits in comparison to R 22 including zero ozone depletion, lower discharge temperature, and higher capacity.

The present invention may confer a number of benefits in comparison to the HFC replacement R407C including superior hydrocarbon oil return, better motor cooling in hermetic compressors, lower discharge temperature and lower discharge pressure.

The invention is further described by means of examples but not in any limitative sense.

EXAMPLE 1

The performances of five R125/R134a/pentane compositions were evaluated using standard refrigeration cycle analysis techniques in order to assess their suitability as retrofit replacements for R22 in hermetic or semi-hermetic systems. The operating conditions, used for the analyses were chosen as being typical of those conditions that are found in air conditioning systems. Since the blends were zeotropes the midpoints of their temperature glides in the evaporator and condenser were chosen to define the temperature

-6-

limits of the cycle. The same temperatures were also used to generate performance data for R22.

The pentane was present at 4% by weight based on the total weight of the R125/R134a blend. To simplify the calculation this small amount of pentane was omitted.

The following refrigerant compositions were subjected to cycle analysis:

1. A composition comprising 44% R125: 56% R134a
2. A composition comprising 56% R125: 44% R134a
3. A composition comprising 64% R125: 36% R134a
4. A composition comprising 76% R125: 24% R134a
5. A composition comprising 80% R125: 20% R134a

The following cycle conditions were used in the analysis:

COOLING DUTY DELIVERED	10 kW
EVAPORATOR	
Midpoint fluid evaporation temperature	7.0 °C
Superheating	5.0 °C
Suction line pressure drop (in saturated temperature)	1.5 °C
CONDENSER	
Midpoint fluid condensing temperature	45.0 °C
Subcooling	5.0 °C
Exhaust line pressure drop (in saturated temperature)	1.5 °C
LIQUID LINE/SUCTION LINE HEAT EXCHANGER	
Efficient	0.3

-7-

COMPRESSOR

Electric motor efficiency	0.85
Compressor isentropic efficiency	0.7
Compressor volumetric efficiency	0.82

PARASITIC POWER

Indoor fan	0.3 kW
Outdoor fan	0.4 kW
Controls	0.1 kW

The results of analysing the performances in an air-conditioning unit using these operating conditions are shown in Table 1. For comparison the performance of R22 is also shown.

All compositions have lower exhaust temperatures than R22 and are therefore superior on this account. However composition 5 is not preferred because the exhaust pressure is more than 2 bar above that of R22. Composition 1 is unacceptable because the refrigerant capacity is less than 90% of that of R22. The overall performances of compositions 2, 3 and 4 meet the criteria set out above and therefore satisfy the requirements of this invention.

EXAMPLE 2

The performances of five R125/R134a/pentane compositions were evaluated using standard refrigeration cycle analysis techniques in order to assess their suitability as retrofit replacements for R22 in open systems. The operating conditions, used for the analyses were chosen as being typical of those conditions that are found in air-conditioning systems. Since the blends were zeotropes the midpoints of their temperature glides in the evaporator and condenser were chosen to define the temperature limits of the cycle. The same temperatures were also used to generate performance data for R22.

The pentane was present at 4% by weight based on the total weight of the R125/R134a blend. To simplify the calculation this small amount of pentane was omitted.

The following refrigerant compositions were subjected to cycle analysis:

-8-

1. A composition comprising 44% R125: 56% R134a
2. A composition comprising 56% R125: 44% R134a
3. A composition comprising 64% R125: 36% R134a
4. A composition comprising 76% R125: 24% R134a
5. A composition comprising 80% R125: 20% R134a

The following cycle conditions were used in the analysis:

COOLING DUTY	10 kW
EVAPORATOR	
Midpoint fluid evaporation temperature	7.0 °C
Superheating	5.0 °C
Suction line pressure drop (in saturated temperature)	1.5 °C
CONDENSER	
Midpoint fluid condensing temperature	45.0 °C
Subcooling	5.0 °C
Exhaust line pressure drop (in saturated temperature)	1.5 °C
LIQUID LINE/SUCTION LINE HEAT EXCHANGER	
Efficiency	0.3
COMPRESSOR	
Electric motor efficiency	0.85
Compressor isentropic efficiency	0.7
Compressor volumetric efficiency	0.82
PARASITIC POWER	
Indoor fan	0.3 kW
Outdoor fan	0.4 kW
Controls	0.1 kW

-9-

The results of analysing the performances in an air-conditioning unit using these operating conditions are shown in Table 2. For comparison the performance of R22 is also shown.

All compositions have lower exhaust temperatures than R22 and are therefore superior on this account. However composition 5 is unacceptable because its exhaust pressure is more than 2 bar above that of R22. Compositions 1 and 2 are unacceptable because their refrigerant capacities are less than 90% of that of R22. The overall performances of compositions 3 and 4 meet the criteria set out above and therefore satisfy the requirements of this invention.

EXAMPLE 3

The performances of five R125/R134a/pentane compositions were evaluated using standard refrigeration cycle analysis techniques in order to assess their suitability as retrofit replacements for R22 in hermetic or semi-hermetic systems not fitted with a liquid line/suction line heat exchanger. The operating conditions, used for the analyses were chosen as being typical of those conditions that are found in air conditioning systems. Since the blends were zeotropes the midpoints of their temperature glides in the evaporator and condenser were chosen to define the temperature limits of the cycle. The same temperatures were also used to generate performance data for R22.

The pentane was present at 4% by weight based on the total weight of the R125/R134a blend. To simplify the calculation this small amount of pentane was omitted.

The following refrigerant compositions were subjected to cycle analysis:

1. A composition comprising 44% R125: 56% R134a
2. A composition comprising 56% R125: 44% R134a
3. A composition comprising 64% R125: 36% R134a
4. A composition comprising 76% R125: 24% R134a
5. A composition comprising 80% R125: 20% R134a

The following cycle conditions were used in the analysis:

-10-

COOLING DUTY	10 kW
EVAPORATOR	
Midpoint fluid evaporation temperature	7.0 °C
Superheating	5.0 °C
Suction line pressure drop (in saturated temperate	1.5 °C
CONDENSER	
Midpoint fluid condensing temperature	45.0 °C
Subcooling	5.0 °C
Exhaust line pressure drop (in saturated temperature)	1.5 °C
COMPRESSOR	
Electric motor efficiency	0.85
Compressor isentropic efficiency	0.7
Compressor volumetric efficiency	0.82
PARASITIC POWER	
Indoor fan	0.47 kW
Outdoor fan	0.26 kW
Controls	0.1 kW

The results from analysing the performances in an air-conditioning unit using these operating conditions are shown in Table 3. For comparison the performance of R22 is also shown.

All compositions have lower exhaust temperatures than R22 and are therefore superior on this account. However composition 5 is unacceptable because its exhaust pressure is more than 2 bar above that of R22. Compositions 1 and 2 are unacceptable because their refrigerant capacities are less than 90% of that of R22. The overall performances of compositions 3 and 4 meet the criteria set out above and therefore satisfy the requirements of this invention.

-11-

EXAMPLE 4

The performances of two R125/R134a/pentane compositions were evaluated using standard refrigeration cycle analysis techniques in order to assess their suitability as extenders for R22 in hermetic or semi-hermetic systems. The operating conditions selected for the analyses are typical of those conditions found in air conditioning systems. Since the blends were zeotropes the midpoints of their temperature glides in the evaporator and condenser were chosen to define the temperature limits of the cycle and were also used to generate the performance of R22 for comparison.

The pentane was present at 4% by weight based on the total weight of the R125/R134a blend. To simplify the calculation this small amount of pentane was omitted.

The following R22 extender compositions were subjected to cycle analysis:

1. A composition comprising 64% R125: 36% R134a.
2. A composition comprising 44% R125: 56% R134a.

To establish the effects on unit performance resulting from successive dilutions of R22 by the above extenders the cycle was analysed for refrigerant compositions containing mass fractions of R22 from 1.0 down to 0.0. The results are summarised in Tables 4a and 4b. Key parameters are plotted in Chart 1 with the calculated points connected by smooth curves.

The following cycle conditions were used in the analysis:

COOLING DUTY	10 kW
EVAPORATOR	
Midpoint fluid evaporation temperature	7.0 °C
Superheating	5.0 °C
Suction line pressure drop (in saturated temperature)	1.5 °C

-12-

CONDENSER

Midpoint fluid condensing temperature	45.0 °C
Subcooling	5.0 °C
Exhaust line pressure drop (in saturated temperature)	1.5 °C

LIQUID LINE

Electric motor efficiency	0.85
Compressor isentropic efficiency	0.7
Compressor volumetric efficiency	0.82

PARASITIC POWER

Indoor fan	0.3 kW
Outdoor fan	0.4 kW
Controls	0.1 kW

All compositions have lower exhaust temperatures than R22 and are therefore superior on this account.

Composition 1 provides a cooling capacity greater than 90% of that of R22 over the whole of the dilution range. Blends containing more than 45% R22 have capacities equal to or better than that of R22. The COP (system) is within 2% of that of R22 over the whole of the dilution range. This composition therefore meets the requirements of this invention.

Composition 2 provides a cooling capacity greater than that 90% of R22 for blends containing down to 20% of R22. Its COP (system) is essentially the same as that of R22 over the whole of the dilution range. This composition therefore meets the requirements of this invention for blends containing down to 20% R22.

EXAMPLE 5

An R32/R134a/pentane composition was evaluated using standard refrigeration cycle analysis techniques to assess its suitability as an extender for R22 in hermetic or

-13-

semi-hermetic systems. The operating conditions selected for the analysis are typical of those conditions found in air conditioning systems. Since the blend was a zeotrope the midpoints of its temperature glides in the evaporator and condenser were chosen to define the temperature limits of the cycle. The same temperatures were also used to generate performance data for R22.

The pentane was present at 4% by weight based on the total weight of the R32/R134a blend. To simplify the calculation this small amount of pentane was omitted.

The following R22 extender composition was subjected to cycle analysis:
A composition comprising 44% R125 by weight, 56% by weight R134a.

To establish the effect on unit performance resulting from successive dilutions of R22 by topping up with the above extender the cycle was analysed for refrigerant compositions containing mass fractions of R22 from 1.0 down to 0.0. The results are shown in Table 5 and the results plotted out in Chart 2 with the calculated points connected by smooth curves.

The following cycle conditions were used in the analysis:

EVAPORATOR

Midpoint fluid evaporation temperature	7.0 °C
Superheating	5.0 °C
Suction line pressure drop (in saturated temperature)	1.5 °C

CONDENSER

Midpoint fluid condensing temperature	45.0 °C
Subcooling	5.0 °C
Exhaust line pressure drop (in saturated temperature)	1.5 °C

LIQUID LINE/SUCTION LINE HEAT EXCHANGER

Efficiency	0.3
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-14-

COMPRESSOR

Electric motor efficiency	0.85
Compressor isentropic efficiency	0.7
Compressor volumetric efficiency	0.82

PARASITIC POWER

Indoor fan	0.3 kW
Outdoor fan	0.4 kW
Controls	0.1 kW

All blends containing the extender have lower exhaust temperatures than R22 and therefore meet the requirements of this specification. The COP (system) is essentially equal to that of R22 over the whole of the dilution range. The cooling capacity of the refrigerant is not less than 98% of that of R22 over the whole of the dilution range. For dilutions down to 20% of R22 the capacity is equal to or greater than that of R22. The exhaust pressure is less than the 0.5 bar above that of R22 over the whole of the dilution range.

The results of analysing the performance of an air-conditioning unit using these operating conditions are shown in Table 5.

R32/R134a 30/70 therefore meets the requirements of this invention.

EXAMPLE 6

An R32/R125/R134a/pentane composition was evaluated using standard refrigeration cycle analysis techniques program to assess its suitability as an extender for R22 in hermetic or semi-hermetic systems. The operating conditions selected for the analysis are typical of those conditions found in air conditioning systems. Since the blend was a zeotrope the midpoints of its temperature glides in the evaporator and condenser were chosen to define the temperature limits of the cycle. The same temperatures were also used to generate performance data for R22.

-15-

The pentane was present at 4% by weight based on the total weight of the R32/R134a blend.

To simplify the calculation this small amount of pentane was omitted.

The following R22 extender composition was subjected to cycle analysis:

A composition comprising 23% by weight of R 32, 25%R125 by weight and 52% by weight R134a.

To establish the effect on unit performance resulting from successive dilutions of R22 by topping up with the above extender the cycle was analysed for refrigerant compositions containing mass fractions of R22 from 1.0 down to 0.0. The results are shown in Table 6 and the results plotted out in Chart 3 with the calculated points connected by smooth curves.

The following cycle conditions were used in the analysis:

EVAPORATOR

Midpoint fluid evaporation temperature	7.0 °C
Superheating	5.0 °C
Suction line pressure drop (in saturated temperature)	1.5 °C

CONDENSER

Midpoint fluid condensing temperature	45.0 °C
Subcooling	5.0 °C
Exhaust line pressure drop (in saturated temperature)	1.5 °C

LIQUID LINE/SUCTION LINE HEAT EXCHANGER

Efficiency	0.3
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COMPRESSOR

Electric motor efficiency	0.8
Compressor isentropic efficiency	0.7
Compressor volumetric efficiency	0.82

-16-

PARASITIC POWER

Indoor fan	0.3
Outdoor fan	0.4 kW
Controls	0.1 kW

The results of analysing the performance of an air-conditioning unit using these operating conditions are shown in Table 6.

All blends containing the extender have lower exhaust temperatures than R22 and therefore meet the requirements of this specification. The COP (system) is not less than 98% of that of R22 over the whole of the dilution range. The cooling capacity of the refrigerant is greater than of that of R22 over the whole of the dilution range. The exhaust pressure is less than the 2.0 bar above that of R22 over the whole of the dilution range.

R32/R134a in the ratio 30/70 therefore meets the requirements of this invention.

EXAMPLE 7

Refrigerant compositions comprising R 125, R 134a and hydrocarbon mixtures in commercial heat pump applications were assessed using a Comfort Aire model PHEC-60-1a 5 ton rooftop heat pump with a nominal cooling capacity of 56,000 btu and nominal heating capacity of 56,000 btu. An oil sight-glass was installed on the hermetic compressor and temperature sensors were installed on the suction and discharge lines and on the liquid line. Suction and discharge gauges were also installed.

The system was operated in both the cooling and heating mode with R 22 and the following data was recorded: voltage, amperage, suction pressure, suction temperature, discharge pressure, discharge temperature, liquid line temperature, evaporator temperature, ambient temperature, oil level and return supply air temperature. The R 22 charge was recovered and replaced successively with blends 1 to 6 of the following compositions.

-17-

	R-125	R-134a	Pentane	Isopentane	Butane
Blend #1	64%	34%	2%		
Blend #2	70%	28%	2%		
Blend #3	55%	43%	2%		
Blend #4	60.5%	37.5%	2%		
Blend #5	45%	52%		1%	2%
Blend #6	55%	42%		1%	2%

It was observed that oil return was similar to R 22 operating levels with all of the blends employed, indicating that pentane and isopentane/butane additives provided proper oil return. Some blends required addition of up to 20% refrigerant to prevent icing of the evaporator. Capacities were found to vary with the composition employed. The energy consumption was generally lower with all blends. Discharge pressures were slightly higher on average with blends that exceeded 60.5% R 125 and lower with blends containing less than 60.5% R 125. The suction pressures and discharge temperatures were lower with all blends used. The superheat measured at the evaporator outlet was much higher than R 22 and the temperature difference across the evaporator was generally greater in the cooling mode and less in the heating mode. It was noted that pentane and isopentane/butane additives provided the necessary oil return. Blends #3, 5 and 6 provided the closest similarities to R 22 operational temperatures and pressures.

-18-

CLAIMS

1. A refrigerant composition comprising 1,1,1,2-tetrafluoroethane (R 134a), pentafluoroethane (R 125) and an additive selected from a saturated hydrocarbon or mixture thereof boiling in the range -5 to $+70^{\circ}\text{C}$; wherein the weights of R 125 to R 134a is in the ranges:

R 125 50 - 80%

R 134a 50 - 20%

2. A refrigerant composition as claimed in claim 1, wherein the weights are in the ranges:

R 125 60 - 80%

R134a 40 - 20%

3. A refrigerant composition as claimed in claim 2, wherein the weights are in the ranges:

R 125 60 - 78%

R 134a 40 - 22%

4. A refrigerant composition as claimed in claim 3, wherein the weights are in the ranges:

R 125 64 - 76%

R 134a 36 - 24%

5. A refrigerant composition as claimed in claim 1, wherein the weights are in the ranges:

R 125 57 - 78%

R 134a 43 - 22%

6. A refrigerant composition as claimed in claim 5, wherein the weights are in the ranges:

R 125 63 - 76%

R 134a 37 - 24%

-19-

7. A refrigerant composition as claimed in any preceding claim, wherein the hydrocarbon additive is selected from the group consisting of 2-methylpropane, 2,2-dimethylpropane, butane, pentane, 2-methylbutane, cyclopentane, hexane, 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane, methylcyclopentane and mixtures thereof.
8. A refrigerant composition as claimed in any preceding claim, wherein the hydrocarbon additive has a boiling point in the range of 20 to 40°C.
9. A refrigerant composition as claimed in claim 8, wherein the hydrocarbon additive is selected from: n-pentane, cyclopentane, iso-pentane and mixtures thereof.
10. A refrigerant composition as claimed in claim 9, wherein the hydrocarbon additive is n-pentane.
11. A refrigerant composition as claimed in claim 9 or 10, wherein the additive further comprises butane.
12. A refrigerant compositions as claimed in claim 11, wherein the ratio of pentane : butane is 1 : 3 to 1 : 8, preferably about 1 : 5.
13. A refrigerant composition as claimed in any preceding claim, wherein the amount of hydrocarbon additive is from a trace to 10%.
14. A refrigerant composition as claimed in claim 13, wherein the amount of hydrocarbon additive is 1 to 8%.
15. A refrigerant composition as claimed in claim 14, wherein the amount of hydrocarbon additive is 2 to 4%.

-20-

16. A refrigerant composition as claimed in any of claims 1 to 15 together with a proportion of R 22.

17. A refrigerant extender mixture comprising a refrigerant composition as claimed in any preceding claim.

18. A method of modifying a refrigerator or air conditioning system which incorporates R 22 as refrigerant, the method comprising the step of adding a refrigerant extender as claimed in claim 17 to the refrigerant of the system.

19. Use of a refrigerant composition as an extender to R 22, wherein the hydrofluorocarbon component comprises R 32, R 125 and R 134a wherein the ratio of weights of R 32, R 125 and R 134a are in the ranges:

R 32	18 - 28%
R 125	20 - 30%
R 134a	42 - 62%

Table 1

Refrigerant % by weight	R-22	1. 125/134a 44/56	2. 125/134a 56/44	3. 125/134a 64/36	4. 125/134a 76/24	5. 125/134a 80/20
Discharge pressure (bar)	17.91	15.89	17.19	18.13	19.68	20.23
Discharge temperature (°C)	104.68	79.75	78.51	77.60	76.07	75.51
COP (system)	2.49	2.50	2.47	2.45	2.41	2.40
Capacity (kW/m ³)	3066	2581	2747	2862	3041	3102
Glide in evaporator (°C)	0	3.06	3.17	3.03	2.47	2.19
Glide in condenser (°C)	0	2.97	2.94	2.71	2.09	1.81

Table 2

Refrigerant % by weight	R-22	1. 125/134a 44/56	2. 125/134a 56/44	3. 125/134a 64/36	4. 125/134a 76/24	5. 125/134a 80/20
Discharge pressure (bar)	17.91	15.89	17.19	18.13	19.68	20.23
Discharge temperature (°C)	92.9	72.8	71.9	71.2	70.1	69.7
COP (system)	2.59	2.57	2.54	2.52	2.48	2.47
Capacity (kW/m ³)	3222	2669	2838	2956	3138	3200
Glide in evaporator (°C)	0	3.06	3.17	3.03	2.47	2.19
Glide in condenser (°C)	0	2.97	2.94	2.71	2.09	1.81

Table 3

Refrigerant % by weight	R-22	1. 125/134a 44/56	2. 125/134a 56/44	3. 125/134a 64/36	4. 125/134a 76/24	5. 125/134a 80/20
Discharge pressure (bar)	17.91	15.89	17.19	18.13	19.68	20.23
Discharge temperature (°C)	94.63	71.81	70.63	69.71	68.082	67.47
COP (system)	2.45	2.42	2.39	2.37	2.33	2.36
Capacity (kW/m ³)	3077	2535	2692	2800	2965	3021
Glide in evaporator (°C)	0	2.88	2.99	2.87	2.34	2.07
Glide in condenser (°C)	0	2.97	2.94	2.71	2.09	1.81

4/11

Table 4a R125/R134a 64%/36% as Extender for R22

Refrigerant % R22 by weight	0	10	20	30	40	50	60	70	80	90	100
Discharge pressure (bar)	18.13	18.47	18.69	18.81	18.84	18.80	18.70	18.56	18.37	18.15	17.91
Discharge temperature (°C)	77.6	79.7	81.8	84.0	86.4	89.0	91.7	94.6	97.8	101.1	104.7
COP (system)	2.45	2.45	2.46	2.46	2.47	2.47	2.48	2.48	2.49	2.49	2.49
Capacity (kW/m ³)	2862	2937	2996	3042	3074	3096	3107	3108	3101	3087	3069
Glide in evaporator (°C)	3.03	2.91	2.66	2.36	2.04	1.73	1.41	1.08	0.75	0.39	0
Glide in condenser (°C)	2.71	2.55	2.31	2.06	1.80	1.54	1.28	1.09	0.71	0.38	0

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Table 4b R125/R134a 44%/56% as Extender for R22

Refrigerant % R22 by weight	0	10	20	30	40	50	60	70	80	90	100
Discharge pressure (bar)	15.90	16.41	16.83	17.17	17.44	17.64	17.79	17.88	17.93	17.93	17.91
Discharge temperature (°C)	79.6	81.7	83.7	85.8	88.0	90.3	92.8	95.5	98.3	101.4	104.7
COP (system)	2.50	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49
Capacity (kW/m ³)	2581	2675	2756	2825	2885	2935	2977	3010	3036	3054	3066
Glide in evaporator (°C)	3.06	3.08	2.91	2.62	2.27	1.89	1.50	1.12	0.74	0.37	0
Glide in condenser (°C)	2.97	2.89	2.66	2.36	2.02	1.69	1.34	1.00	0.67	0.34	0

Table 5 R32/134a 30/70 as an Extender for R22

Refrigerant % R22 by weight	0	10	20	30	40	50	60	70	80	90	100
Discharge pressure (bar)	18.08	18.18	18.27	18.33	18.36	18.36	18.34	18.28	18.19	18.07	17.91
Discharge temperature (°C)	98.0	98.4	98.9	99.3	99.8	100.4	101.0	101.8	102.6	103.6	104.7
COP (system)	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49
Capacity (kW/m ³)	3030	3049	3066	3080	3091	3098	3101	3100	3094	3083	3066
Glide in evaporator (°C)	5.03	4.59	4.12	3.62	3.11	2.59	2.07	1.55	1.03	0.51	0
Glide in condenser (°C)	5.13	4.62	4.11	3.60	3.08	2.57	2.07	1.56	1.06	0.54	0

Table 6 R32/125/134a 23/25/52 as an Extender for R22

Refrigerant % R22 by weight	0	10	20	30	40	50	60	70	80	90	100
Discharge pressure (bar)	19.30	19.32	19.30	19.25	19.16	19.03	18.87	18.68	18.45	18.20	17.91
Discharge temperature (°C)	92.5	93.3	94.1	95.0	96.0	97.1	98.4	99.7	101.2	102.9	104.7
COP (system)	2.47	2.47	2.47	2.47	2.47	2.48	2.48	2.48	2.49	2.49	2.49
Capacity (kW/m ³)	3172	3183	3190	3193	3191	3183	3171	3157	3129	3101	3066
Glide in evaporator (°C)	4.8	4.4	3.9	3.4	2.9	2.4	1.9	1.5	1.0	0.5	0
Glide in condenser (°C)	4.7	4.2	3.8	3.3	2.8	2.4	1.9	1.5	1.0	0.5	0

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8/11

TABLE 7

COMMERCIAL ROOF TOP HEAT PUMP 5 TON

	R-22	BLEND 1	BLEND 3	BLEND 4	BLEND 5	BLEND 6	BLEND 7
WT% COMPOSITION		64/34/2	70/28/2	55/43/2	60.5/37.5/2	45/52/1/2	55/42/1/2
COOLING MODE							
ADDITIONAL REFR. REQ'D		.9 KG	.9 KG	NONE	.9 KG	NONE	NONE
SUCTION PRESSURE	4.48	3.5	3.37	3.03	3.45	2.69	3.1
SUCTION TEMPERATURE	18	22	19.4	27	20	22	21.7
DISCHARGE PRESSURE	13.1	13.5	13.17	12.68	12.42	11.25	12.42
DISCHARGE TEMP.	90	80	73	81	72	76	76
LIQ. LINE TEMP.	31	29	26	32	26	26	26
AMBIENT TEMPERATURE	22	24	21.7	26	21.2	22	22
OIL LEVEL	10.8CM	10.8 CM	10.8 CM	10.8 CM	10.8 CM	10.8 CM	10.8 CM
AMPERAGE	22.27	19.86	19.64	17.72	19.06	16.13	17.83
VOLTAGE	200	201	199	200	199	203	200
EVAPORATOR TEMP.	7.2	3.9	2.2	4	5	1.7	2.3
AIR TEMP. DIFFERENCE	12.2	17.7	16.1	19.7	14.4	17.3	16.1
SUPERHEAT	9.1	21	19.4	28	20	26	23.3
HEATING MODE							
SUCTION PRESSURE	4.82	4.97	4.9	3.6	4.69	3.45	3.72
SUCTION TEMP.	25	23	23	26	22	23	22
DISCHARGE PRESSURE	20.34	25.5	25.6	19.3	24	17.94	19.3
DISCHARGE TEMP.	120	98	98	95	94	91	91
LIQ. LINE TEMP.	32.2	30	30	32	29	27	26
AMBIENT TEMP.	24.2	24	22.2	25	22.4	22	20
OIL LEVEL	10.8CM	10.8 CM	10.8 CM	10.8 CM	10.8 CM	10.8 CM	10.8 CM
AMPERAGE	28.97	28.08	27.63	21.9	26.72	20.77	22.54
VOLTAGE	198	199	198	199	198	203	199
EVAPORATOR TEMP.	41	36.2	36.1	36.1	34	32	31
AIR TEMP. DIFFERENCE	11.1	7.8	7.8	6.3	7.6	7.2	7.5
SUPERHEAT	NA	NA	NA	NA	NA	NA	NA

PRESSURES ARE IN BARS GAUGE PRESSURE

TEMPERATURES ARE IN CELSIUS

ALL READINGS ARE AVERAGES OVER SEVERAL HOURS OF OPERATION

OIL LEVEL MEASURED IN CENTIMETRES

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9/11

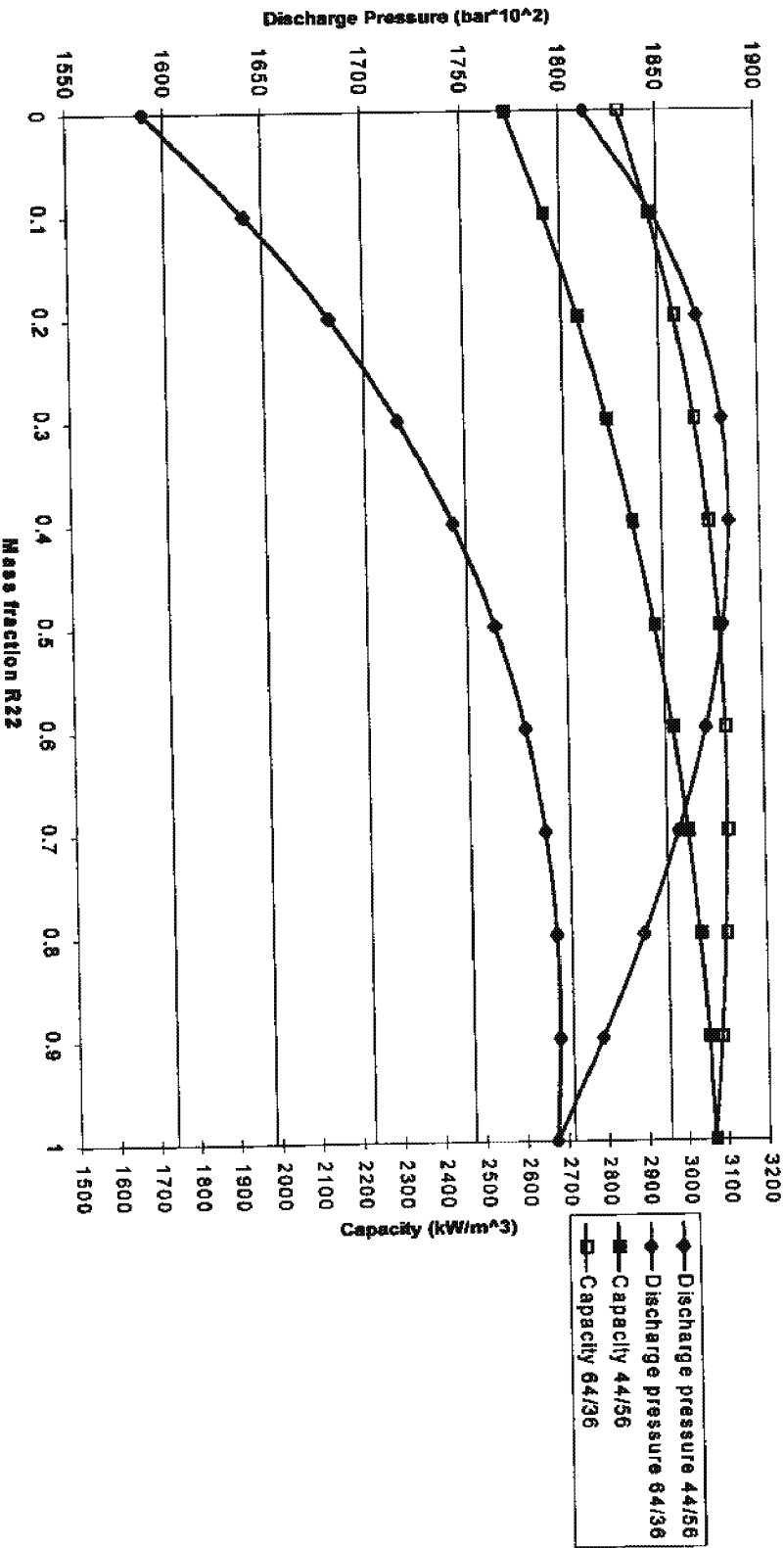
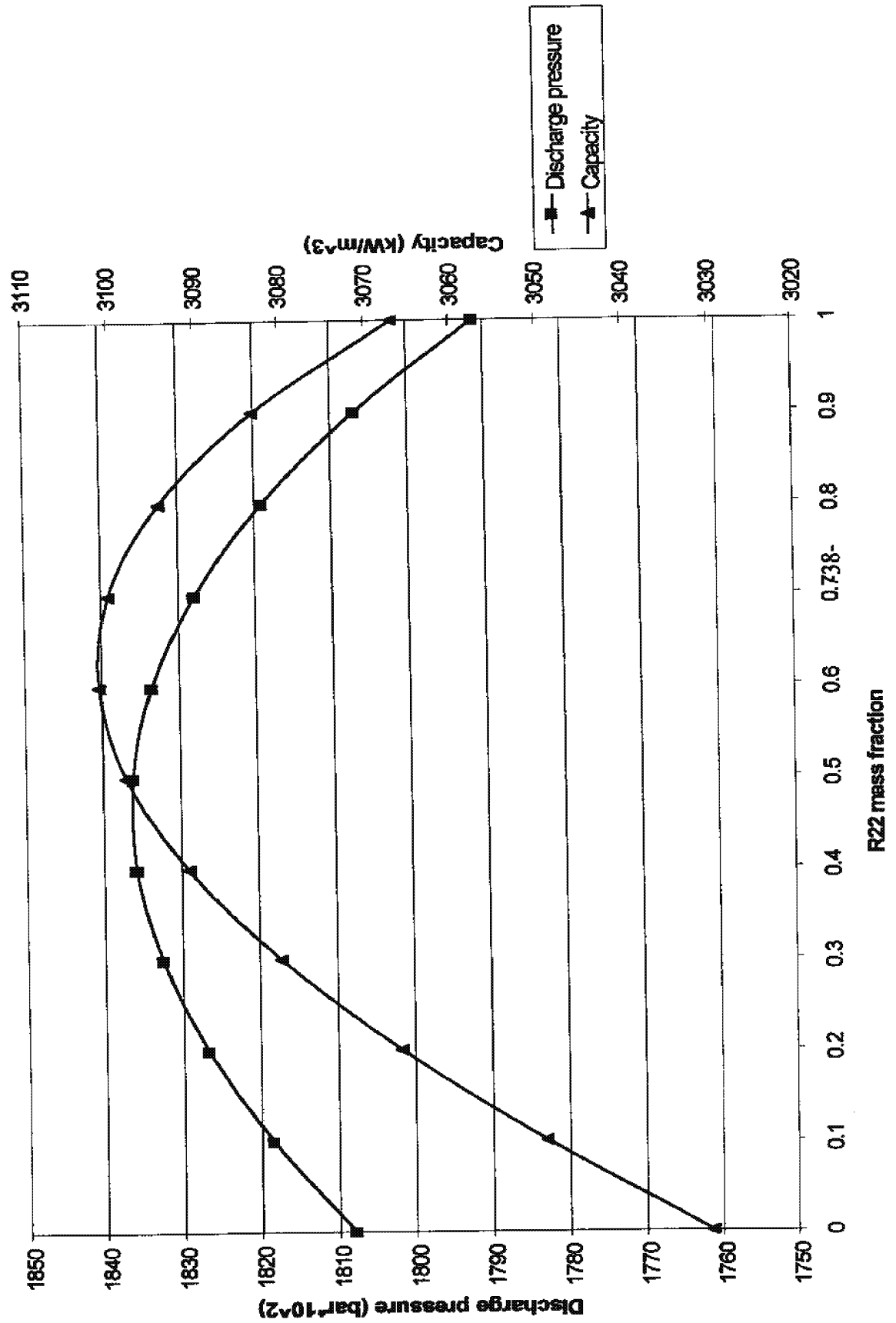


Figure 1: R126/134a 64/36 and 44/56 as R22 Extenders

Figure 2: R32(30)/R134a(70) as an extender for R22



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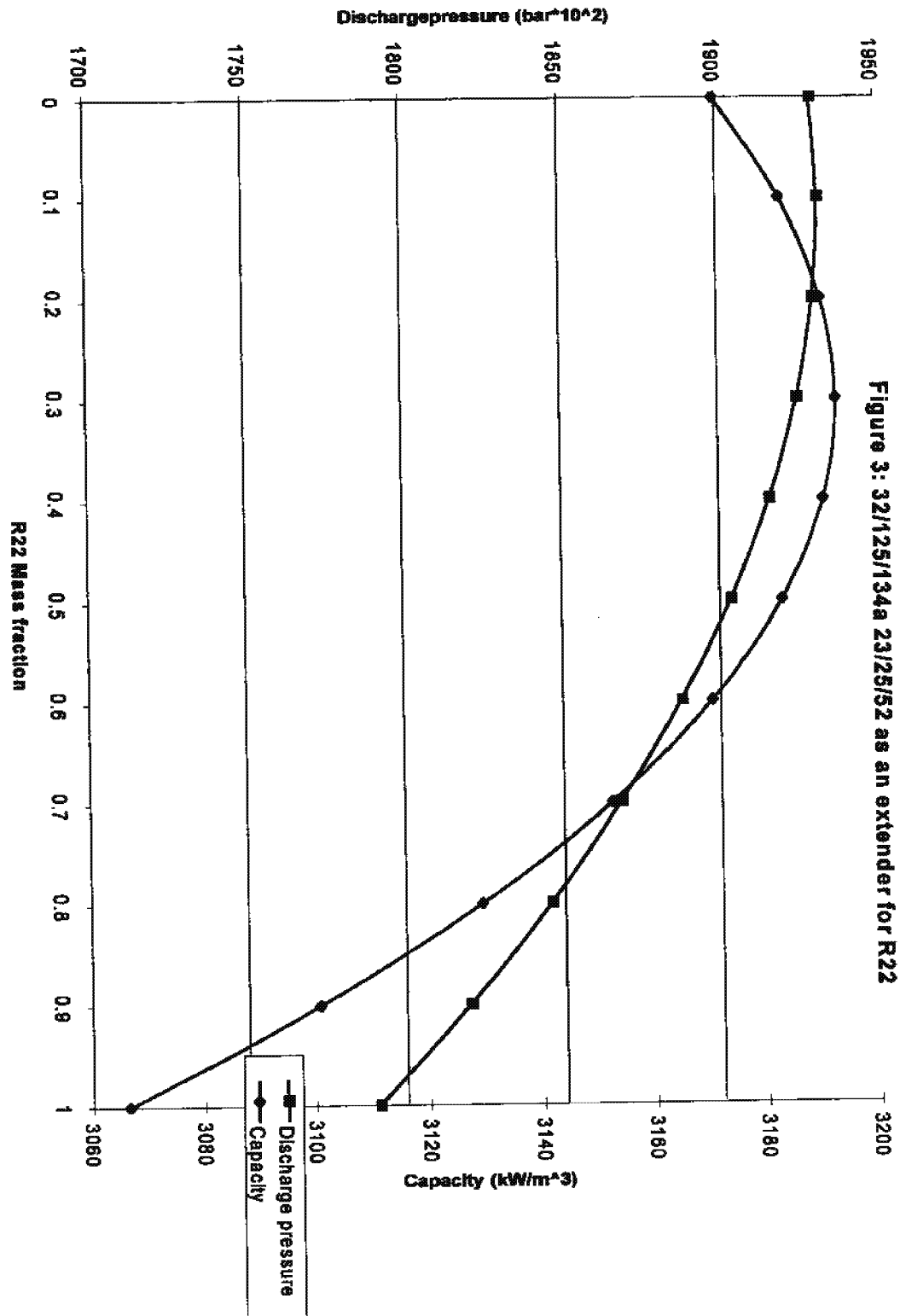


Figure 3: 32/125/134a 23/25/52 as an extender for R22

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/03725

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C09K5/04

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 C09K

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, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 0 539 952 A (MATSUSHITA ELECTRIC IND CO LTD) 5 May 1993 (1993-05-05) table 3	1-19
A	EP 0 811 670 A (MATSUSHITA ELECTRIC IND CO LTD) 10 December 1997 (1997-12-10) abstract	1-19
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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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

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Date of the actual completion of the international search

1 December 2000

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INTERNATIONAL SEARCH REPORT

International Application No.

PCT/GB 00/03725

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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