"STAR REFRIGERATION LIMITED"

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1. **1997025142** SCRAPED SURFACE EVAPORATORS AU - 08.01.1998

Int.Class F28F 19/00 **Appl.No** 25142/97 **Applicant** Star Refrigeration Limited **Inventor** Pearson, Stephen Forbes

The present invention relates to scraped surface evaporators (10), and in particular to scrapers (30) for use in scraping the surface of the evaporator (10). Such scraped surface evaporators (10) comprise a refrigerated drum (12), the inner surface of which is scraped by the scraper(s) (30). The scraper is mounted on drive means (16), which are arranged to rotate about the longitudinal axis of the drum (12). The scraper comprises a leading edge region (32) and a trailing edge region (34), with the leading edge formed into a blade (44). A biasing force is applied to the scraper (30) so that the blade (44) and a trailing edge (48) are biased into contact with the surface (46) to be scraped.

2. **2237110** CENTRIFUGAL COMPRESSION REFRIGERANT COMPOSITION CA - 15.05.1997

Int.Class C09K 5/04 **Appl.No** 2237110 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, STEPHEN FORBES

A refrigerant composition which is suitable as a substitute for conventional refrigerant R12 in a vapour compression system employing a centrifugal compressor, comprises a mixture of tetrafluoroethane and at least one additional refrigerant. The refrigerant mixture has a vapour density which renders it suitable for use as an R12 replacement in a centrifugal compression refrigeration system. The molecular weight of the mixture approximates 121. Preferred mixtures include 67 wt.% tetrafluoroethane and 33 wt.% octafluoropropane; 69 wt.% tetrafluoroethane and 31 wt.% octafluorocyclobutane; and 66 wt.% tetrafluoroethane and 34 wt.% heptafluoropropane. Refrigeration effect and coefficient of performance are similar to R12.

3. **1996075017** CENTRIFUGAL COMPRESSION REFRIGERANT COMPOSITION AU - 24.07.1997

Int.Class C09K 5/04 **Appl.No** 75017/96 **Applicant** Star Refrigeration Limited **Inventor** Pearson, Stephen Forbes

A refrigerant composition which is suitable as a substitute for conventional refrigerant R12 in a vapour compression system employing a centrifugal compressor, comprises a mixture of tetrafluoroethane and at least one additional refrigerant. The refrigerant mixture has a vapour density which renders it suitable for use as an R12 replacement in a centrifugal compression refrigeration system. The molecular weight of the mixture approximates 121. Preferred mixtures include 67 wt.% tetrafluoroethane and 33 wt.% octafluoropropane; 69 wt.% tetrafluoroethane and 31 wt.% octafluorocyclobutane; and 66 wt.% tetrafluoroethane and 34 wt.% heptafluoropropane. Refrigeration effect and coefficient of performance are similar to R12.

4. **6248255** CENTRIFUGAL COMPRESSION REFRIGERANT COMPOSITION US - 19.06.2001

Int.Class C09K 5/04 **Appl.No** 09068367 **Applicant** Star Refrigeration Limited **Inventor** Pearson, Stephen Forbes

A refrigerant composition which is suitable as a substitute for conventional refrigerant R12 in a vapour compression system employing a centrifugal compressor, comprises a mixture of tetraflouroethane and at least one additional refrigerant. The refrigerant mixture has a vapour density which renders it suitable for use as an R12 replacement in a centrifugal compression refrigeration system. The molecular weight of the mixture approximates 121. Preferred mixtures include 67 wt. % tetraflouroethane and 33 wt. % octafluoropropane; 69 wt. % tetrafluoroethane and 31 wt. % octafluorocyclobutane; and 66 wt. % tetrafluoroethane and 34 wt. % heptafluoropropane. Refrigeration effect and coefficient of performance are similar to R12.

5. **20100199707** REFRIGERATION SYSTEM US - 12.08.2010

Int.Class F25D 17/02 **Appl.No** 12702386 **Applicant** Star Refrigeration Limited **Inventor** Pearson Andrew Brash

A refrigerating system comprises a compressor (**1**A, **1**B, **1**C), a heat rejection device (**2**), an expansion device (**15**), an evaporator (**5**A, **5**B, **5**C) and a receiver (**4**), capable of operating with the compressor discharge higher than the critical pressure of the refrigerant; where

- the flow outlet from the heat rejection device is regulated by a pressure control valve (**7**),
- the pressure downstream of the pressure control valve is regulated by a gas vent valve (**8**),
- the refrigerant flow to the evaporator is further regulated by an automatic control device (**41, 52, 14**) at the inlet to the evaporator, and
- the automatic control device being set to permit intermittent flow of liquid refrigerant to the receiver during normal operation of the system. The refrigerant may be carbon dioxide, which may operate under transcritical pressures e.g. 80 to 120 bar absolute. The receiver acts as a trap for any liquid from the evaporator and ensures that the gas flow to the compressor suction is dry.

6. **577589** AIR-SOURCE HEAT PUMP NZ - 27.05.2011

Int.Class F24H 4/02 **Appl.No** 577589 **Applicant** Star Refrigeration Limited **Inventor** PEARSON, Stephen, Forbes

Patent 577589 The air-source heat pump consists of compressor 1, condenser 2, expansion valve 3 and evaporator 4, so that heat extracted from ambient temperature air in evaporator 4 is rejected at a higher temperature from condenser 2. The heat pump also has an auxiliary heater, for prevention of deposition of frost on the evaporator, as a combustion heater 7. Flue gas 12 from the combustion heater mixes with ambient air 10 before passing over the evaporator 4. A heated fluid circuit, typically of water to be heated, is passed through condenser 2 and then through the combustion heater 7 with the combustion heater heating the fluid.

7. **2007336039** AIR-SOURCE HEAT PUMP AU - 09.07.2009

Int.Class F24H 4/02 **Appl.No** 2007336039 **Applicant** STAR REFRIGERATION LIMITED **Inventor** Pearson, Stephen Forbes

An air source heat pump wherein heat is extracted from air at ambient temperature in an evaporator [4] and heat is rejected at a higher temperature in a condenser [2]; further comprises an auxiliary heater [7] arranged to preheat the ambient air when required to prevent deposition of frost on the evaporator. The combustion heater may be a gas fired boiler, arranged to heat recirculating water for supplying heating radiators and wherein the flue gases mix with the ambient air before it passes over the evaporator.

8. **3595/DELNP/2009** AIR-SOURCE HEAT PUMP IN - 16.04.2010

Int.Class F24H 4/02 **Appl.No** 3595/DELNP/2009 **Applicant** STAR REFRIGERATION LIMITED **Inventor** STEPHEN FORBES PEARSON

AIR SOURCE HEAT PUMP An air source heat pump wherein heat is extracted from air at ambient temperature in an evaporator 4 and heat is rejected at a higher temperature in a condenser 2; further comprises an auxiliary heater 7 arranged to preheat the ambient air when required to prevent deposition of frost on the evaporator. The combustion heater may be a gas fired boiler, arranged to heat recirculating water for supplying heating radiators and wherein the flue gases mix with the ambient air before it passes over the evaporator.

9. **20100077779** AIR-SOURCE HEAT PUMP US - 01.04.2010

Int.Class F25B 27/00 **Appl.No** 12516974 **Applicant** Star Refrigeration Limited **Inventor** Pearson Stephen F.

An air source heat pump wherein heat is extracted from air at ambient temperature in an evaporator [**4**] and heat is rejected at a higher temperature in a condenser [**2**]; further comprises an auxiliary heater [**7**] arranged to preheat the ambient air when required to prevent deposition of frost on the evaporator. The combustion heater may be a gas fired boiler, arranged to heat recirculating water for supplying heating radiators and wherein the flue gases mix with the ambient air before it passes over the evaporator.

10. **2672831** AIR-SOURCE HEAT PUMP CA - 26.06.2008

Int.Class F24H 4/02 **Appl.No** 2672831 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, STEPHEN FORBES

An air source heat pump wherein heat is extracted from air at ambient temperature in an evaporator [4] and heat is rejected at a higher temperature in a condenser [2]; further comprises an auxiliary heater [7] arranged to preheat the ambient air when required to prevent deposition of frost on the evaporator. The combustion heater may be a gas fired boiler, arranged to heat recirculating water for supplying heating radiators and wherein the flue gases mix with the ambient air before it passes over the evaporator.

11. **20050044885** TRANSCRITICAL REFRIGERATION CYCLE US - 03.03.2005

Int.Class F04B 25/00 **Appl.No** 10887520 **Applicant** Star Refrigeration Limited **Inventor** Pearson Stephen Forbes

A transcritical vapour compression refrigeration apparatus including: a compressor, a gas cooler, an economiser, an evaporator and a refrigerant; the refrigerant being compressed in the compressor, heat being rejected from the compressed refrigerant at supercritical pressure in the gas cooler, the cooled compressed refrigerant being then expanded in a first stage to first temperature and pressure conditions in the economiser and then expanded in a second stage to second temperature and pressure conditions; a stream of refrigerant from the economiser at said first temperature and pressure conditions then being compressed in a first stream in the compressor, refrigerant at said second temperature and pressure conditions absorbing heat in the evaporator and then being compressed in a separate second stream in the compressor; said first and second compressed streams then being combined before passing to the gas cooler or passing through separate gas coolers before being combined.

12. **5688432** REPLACEMENT REFRIGERANT COMPOSITION US - 18.11.1997

Int.Class C09K 5/04 **Appl.No** 08619720 **Applicant** Star Refrigeration Limited **Inventor** Pearson Stephen Forbes

A refrigerant composition for use in a vapour-compression refrigeration apparatus as a replacement for currently used refrigerants R22 and R12 comprises a mixture of pentafluoroethane [R125], tetrafluoroethane [R134a], a hydrocarbon selected from isobutane [R600a] and propane [R290], and optionally octafluoroethane [R218]. The composition contains no chlorine atoms and is non-depleting to atmospheric ozone; but specific compositions have pressure-temperature relations substantially the same as R22 and R12 thereby allowing their use as direct replacements therefor in existing refrigeration apparatus.

13. **1994076609** REPLACEMENT REFRIGERANT COMPOSITION AU - 01.06.1995

Int.Class C07C 9/08 **Appl.No** 76609/94 **Applicant** Star Refrigeration Limited **Inventor** Pearson, Stephen Forbes

A refrigerant composition for use in a vapour-compression refrigeration apparatus as a replacement for currently used refrigerants R22 and R12 comprises a mixture of pentafluoroethane [R125], tetrafluoroethane [R134a], a hydrocarbon selected from isobutane [R600a] and propane [R290], and optionally octafluoroethane [R218]. The composition contains no chlorine atoms and is non-depleting to atmospheric ozone; but specific compositions have pressure-temperature relations substantially the same as R22 and R12 thereby allowing their use as direct replacements therefor in existing refrigeration apparatus.

14. **2010238347** EVAPORATIVE COOLING DEVICE AU - 08.12.2011

Int.Class F28F 25/10 **Appl.No** 2010238347 **Applicant** Star Refrigeration Limited **Inventor** Pearson, Stephen Forbes

An evaporative cooler for cooling a fluid contained in an array of spaced heat exchange elements by heat transfer to a cooling liquid flowing downwardly around the elements in counter current flow to an upwardly flowing gas; comprises a casing [1] housing the array [2] of spaced heat exchange elements, the gas flowing upwardly through the casing, and humid gas leaving the casing at an upper end; a restrictor [3] comprising a series of apertures [3a] located below the array of spaced heat exchange elements; the spaces between the heat exchange elements being aligned with the apertures, such as to provide substantially straight upwardly directed gas-flow channels through the heat exchange array; gas being drawn into the casing through the restrictor apertures and producing a pressure drop sufficient to inhibit loss of cooling liquid from a lower end of the cooler; and a coalescer [6] located above the heat exchange array, such that liquid droplets entrained in the upward gas flow are captured and coalesced to a size whereby coalesced liquid droplets falls down onto the heat exchange array. The restrictor apertures may be slots or holes. The heat exchange elements may be tubes or hollow plates.

15. **2758789** EVAPORATIVE COOLING DEVICE — CA - 21.10.2010

Int.Class F28F 25/10 **Appl.No** 2758789 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, STEPHEN FORBES

An evaporative cooler for cooling a fluid contained in an array of spaced heat exchange elements by heat transfer to a cooling liquid flowing downwardly around the elements in counter current flow to an upwardly flowing gas; comprises a cas-ing (1) housing the array (2) of spaced heat exchange elements, the gas flowing upwardly through the casing, and humid gas leav-ing the casing at an upper end; a restrictor (3) comprising a series of apertures (3a) located below the array of spaced heat ex-change elements; the spaces between the heat exchange elements being aligned with the apertures, such as to provide substantially straight upwardly directed gas-flow channels through the heat exchange array; gas being drawn into the casing through the restric-tor apertures and producing a pressure drop sufficient to inhibit loss of cooling liquid from a lower end of the cooler; and a coa-lescer (6) located above the heat exchange array, such that liquid droplets entrained in the upward gas flow are captured and coa-lesced to a size whereby coalesced liquid droplets falls down onto the heat exchange array. The restrictor apertures may be slots or holes. The heat exchange elements may be tubes or hollow plates.

16. **PI1014231** RESFRIADOR EVAPORATIVO, REFRIGERADOR DE LÍQUIDO DE CIRCUITO, E, APARELHO DE REFRIGERAÇÃO — BR - 12.04.2016

Int.Class F28D 5 **Appl.No** PI1014231 **Applicant** Star Refrigeration Limited **Inventor** Stephen Forbes Pearson

abstract not avaible

17. **8817/DELNP/2011** EVAPORATIVE COOLING DEVICE — IN - 15.02.2013

Int.Class F28F 25/10 **Appl.No** 8817/DELNP/2011 **Applicant** STAR REFRIGERATION LIMITED **Inventor** STEPHEN FORBES PEARSON

An evaporative cooler for cooling a fluid contained in an array of spaced heat exchange elements by heat transfer to a cooling liquid flowing downwardly around the elements in counter current flow to an upwardly flowing gas; comprises a cas¬ing (1) housing the array (2) of spaced heat exchange elements, the gas flowing upwardly through the casing, and humid gas leav¬ing the casing at an upper end; a restrictor (3) comprising a series of apertures (3a) located below the array of spaced heat ex¬change elements: the spaces between the heat exchange elements being aligned with the apemues, such as to provide substantially straight upwardly directed gas-flow channels through the heat exchange array, gas being drawn into the casing through the restric¬tor apemurs and producing a pressure drop sufficient to inhibit loss of cooling liquid from a lower eud of the cooler; and a coa-lescer (6) located above the heat exchange array, such that liquid droplets entrained in the upward gas flow are captured and coa¬lesced to a size whereby coalesced liquid droplets falls down onto the heat exchange array. The restrictor apertures may be slots or boles. The heat exchange elements may be tubes or hollow plates.

18. **2000018747** VAPORISABLE COMPOSITION — AU - 14.09.2000

Int.Class C09K 5/04 **Appl.No** 18747/00 **Applicant** Star Refrigeration Limited **Inventor** Pearson, Stephen Forbes

A vaporisable composition for use as a replacement for conventional refrigerants R22 and R502 comprises 40-90 % by weight fluoroethane (R161) and 10-60 % by weight trifluoroiodomethane (R13I1). It may further comprise octafluoropropane (R218).

19. **WO/1992/016596** THREE-COMPONENT REFRIGERANT — WO - 01.10.1992

Int.Class C09K 5/04 **Appl.No** PCT/GB1991/000439 **Applicant** STAR REFRIGERATION LIMITED **Inventor**

A three component refrigerant composition for use in vapour compression refrigerators and avoiding the use of ozone-depleting chlorofluorocarbons comprises a three component mixture of: (i) a major portion comprised of chlorodifluoromethane (R22) or pentafluoroethane (R125); (ii) R125 or octafluoropropane (R218); and (iii) propane, in non-flammable proportions.

20. **WO/1997/017414** CENTRIFUGAL COMPRESSION REFRIGERANT COMPOSITION — WO - 15.05.1997

Int.Class C09K 5/04 **Appl.No** PCT/GB1996/002733 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, Stephen, Forbes

A refrigerant composition which is suitable as a substitute for conventional refrigerant R12 in a vapour compression system employing a centrifugal compressor, comprises a mixture of tetrafluoroethane and at least one additional refrigerant. The refrigerant mixture has a vapour density which renders it suitable for use as an R12 replacement in a centrifugal compression refrigeration system. The molecular weight of the mixture approximates 121. Preferred mixtures include 67 wt.% tetrafluoroethane and 33 wt.% octafluoropropane; 69 wt.% tetrafluoroethane and 31 wt.% octafluorocyclobutane; and 66 wt.% tetrafluoroethane and 34 wt.% heptafluoropropane. Refrigeration effect and coefficient of performance are similar to R12.

21. **WO/2007/020472** HEATING SYSTEM — WO - 22.02.2007

Int.Class F25B 29/00 **Appl.No** PCT/GB2006/003128 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, Stephen, Forbes

A heating system, particularly a water heating system (10) comprises a heat pump (12) utilising a working fluid in a transcritical cycle, and a heat inlet heat exchanger (14) and a heat outlet heat exchanger (18). The heat inlet heat exchanger (14), in use, is positioned adjacent a heat source (22) comprising liquid chilled by a separate refrigeration system (50). In one disclosed embodiment the separate refrigeration system (50) forms part of an air conditioning system (24).

22. **WO/2005/001345** IMPROVED COOLING SYSTEM — WO - 06.01.2005

Int.Class F25B 25/00 **Appl.No** PCT/GB2004/002654 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, Stephen, Forbes

A refrigeration apparatus employing a primary vapour-compression refrigeration circuit and a secondary refrigeration circuit is able to selectively operate in pumped vapour-compression mode or thermosyphon mode. The refrigeration apparatus comprises a primary refrigeration circuit (100) arranged to cool a secondary refrigeration circuit (200) having a thermal load (20); (i) the primary vapour-compression refrigeration circuit comprising a compressor (2) for compressing a volatile primary refrigerant, a condenser (1) an expansion device (5) and an evaporator (4); and (ii) the secondary refrigeration circuit comprising a condenser (14) for rejecting heat from a volatile secondary refrigerant, the condenser being in thermal contact with the primary evaporator and cooled thereby; and means (20) for cooling the thermal load; the primary refrigeration circuit further comprising bypass means (6, 7) selectably operative to bypass the primary compressor and primary expansion device, so as to allow alternative refrigerant circulation through the primary refrigeration circuit by thermosyphon.

23. **WO/1995/008602** REPLACEMENT REFRIGERANT COMPOSITION WO - 30.03.1995

Int.Class C09K 5/04 **Appl.No** PCT/GB1994/002042 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, Stephen, Forbes

A refrigerant composition for use in a vapour-compression refrigeration apparatus as a replacement for currently used refrigerants R22 and R12 comprises a mixture of pentafluoroethane (R125), tetrafluoroethane (R134a), a hydrocarbon selected from isobutane (R600a) and propane (R290), and optionally octafluoroethane (R218). The composition contains no chlorine atoms and is non-depleting to atmospheric ozone; but specific compositions have pressure-temperature relations substantially the same as R22 and R12 thereby allowing their use as direct replacements therefor in existing refrigeration apparatus.

24. **WO/2010/119250** EVAPORATIVE COOLING DEVICE WO - 21.10.2010

Int.Class F28F 25/10 **Appl.No** PCT/GB2010/000750 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, Stephen Forbes

An evaporative cooler for cooling a fluid contained in an array of spaced heat exchange elements by heat transfer to a cooling liquid flowing downwardly around the elements in counter current flow to an upwardly flowing gas; comprises a casing (1) housing the array (2) of spaced heat exchange elements, the gas flowing upwardly through the casing, and humid gas leaving the casing at an upper end; a restrictor (3) comprising a series of apertures (3a) located below the array of spaced heat exchange elements; the spaces between the heat exchange elements being aligned with the apertures, such as to provide substantially straight upwardly directed gas-flow channels through the heat exchange array; gas being drawn into the casing through the restrictor apertures and producing a pressure drop sufficient to inhibit loss of cooling liquid from a lower end of the cooler; and a coalescer (6) located above the heat exchange array, such that liquid droplets entrained in the upward gas flow are captured and coalesced to a size whereby coalesced liquid droplets falls down onto the heat exchange array. The restrictor apertures may be slots or holes. The heat exchange elements may be tubes or hollow plates.

25. **WO/2008/074990** AIR-SOURCE HEAT PUMP WO - 26.06.2008

Int.Class F24H 4/02 **Appl.No** PCT/GB2007/004722 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, Stephen, Forbes

An air source heat pump wherein heat is extracted from air at ambient temperature in an evaporator (4) and heat is rejected at a higher temperature in a condenser (2); further comprises an auxiliary heater (7) arranged to preheat the ambient air when required to prevent deposition of frost on the evaporator. The combustion heater may be a gas fired boiler, arranged to heat recirculating water for supplying heating radiators and wherein the flue gases mix with the ambient air before it passes over the evaporator.

26. **WO/2000/039242** VAPORISABLE COMPOSITION WO - 06.07.2000

Int.Class C09K 3/30 **Appl.No** PCT/GB1999/004332 **Applicant** STAR REFRIGERATION LIMITED **Inventor** PEARSON, Stephen, Forbes

A vaporisable composition for use as a replacement for conventional refrigerants R22 and R502 comprises 40-90 % by weight fluoroethane (R161) and 10-60 % by weight trifluoroiodomethane (R13I1). It may further comprise octafluoropropane (R218).

27. **1502607** LOW PRESSURE RECEIVERS FOR A REFRIGERATING SYSTEM GB - 01.03.1978

Int.Class F25B 1/00 **Appl.No** 3612474 **Applicant** STAR REFRIGERATION **Inventor**

1502607 Refrigeration STAR REFRIGERATION Ltd 19 May 1975 [16 Aug 1974] 36124/74 Heading F4H A low pressure receiver for a compressioncondensation refrigeration system comprises a housing 1 having ports 2, 3 for connection to the evaporator outlet and compressor inlet, respectively, and containing a conduit 4 which extends to the outlet port 3 and which has a portion in heat exchange relationship with a portion 9 of a high pressure circuit 50 extending within the housing between a connection 6 to the condenser outlet and a connection 7 to the evaporator inlet. A second portion 10 of the high pressure circuit 5 is in heat exchange relationship with liquid accumulated in the bottom of the housing 1. As shown, the connection 7 to the evaporator inlet includes a float valve 12, and a gas balance connection 13 connects the valve to an upward loop 14 of the high pressure circuit and has a lower flow resistance to vapour than the heat exchanger portions when these are filled with liquid. A third heat exchanger 8 is provided between the inlet and the heat exchanger 9 to boil a continuous supply of liquid from the condenser for oil recovery purposes. The heat receiving portion of the heat exchanger has an outlet pipe 11 looped upwardly so as to descend to the conduit 4 and hence to the suction side of the compressor. In a second embodiment, Fig. 2 (not shown), the float valve is replaced by a manually-operable expansion valve 15.