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(54) Title: FLEXIBLE HOSE

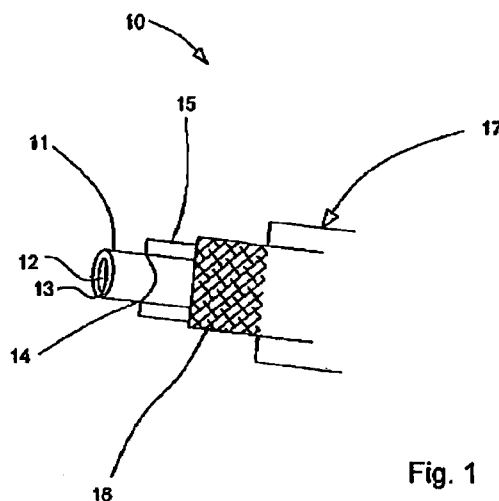


Fig. 1

(57) Abstract: Flexible hose including: a core layer having a lumen extending axially therethrough and an outer surface, the core layer being formed from flexible material suitable for contact with domestic air conditioning refrigerant fluids; an adhesive layer formed onto the outer surface of the core layer is sufficient coverage to provide an adhesive layer; a protective layer formed onto the adhesive layer, the protective layer being formed from flexible, compressible and heat insulating material and having an outer resilient surface; a reinforcing layer formed from braided material onto the outer resilient surface to provide an outer reinforced surface; and a finishing layer formed onto the outer resilient surface for protecting the reinforcing layer and retaining same in place on the protective layer.



Flexible Hose

This invention relates to flexible hose. The invention has particular application to flexible hose for use in air conditioning fluid transport in fixed structures, particularly in domestic applications and reference will be made to such application. However, the invention may be found to be useful in other application where fluid transport of similar fluids is desired or required. Accordingly, the term fixed structures is to be taken to encompass domestic, industrial and commercial applications. For convenience, the term "domestic air conditioning" will be used in this specification, and is to be taken to include commercial and industrial air conditioning unless the context indicates otherwise.

Domestic air conditioning fluid transport is traditionally accomplished with the use of lagged or insulated copper tubing or pipe, normally rigid pipe. Whilst this form of conduit performs well from a technical point of view, copper tubing can be expensive and difficult to install in some locations. Flexible hose is used in some non-domestic air conditioning systems, particularly automotive air conditioning. However, such hose is not suitable for application in domestic air conditioning.

The present invention aims to provide flexible hose which alleviates one or more of the aforementioned problems. Other

aims and advantages of the invention may become apparent from the following description.

With the foregoing in view, in one aspect the present invention resides broadly in flexible hose including:

- 5 a core layer having a lumen extending axially therethrough and an outer surface, the core layer being formed from flexible material suitable for contact with, and prevention of permeation radially therethrough of, domestic air conditioning refrigerant fluids;
- 10 an adhesive layer formed onto the outer surface of the core layer is sufficient coverage to provide an adhesive layer;

 a protective layer formed onto the adhesive layer, the protective layer being formed from flexible, compressible and
15 heat insulating material and having an outer resilient surface;
- a reinforcing layer formed from braided material onto the outer resilient surface to provide an outer reinforced surface; and
- 20 a finishing layer formed onto the outer resilient surface for protecting the reinforcing layer and retaining same in place on the protective layer.

Preferably, the core layer is formed from nylon suited for contact with domestic air conditioning refrigerant such as 410A, which is a blend of difluoromethane and pentafluoroethane, such as, for example, polyamide 6. The core
5 layer is preferably flexible to the extent that the hose may be bent to a tight radius without kinking. The core layer is selected for form a barrier layer against the permeation of of the refrigerant through the wall of the hose.

Preferably, the protective layer is formed from
10 elastomer, such as nitrile rubber. The rubber may be foamed or softened to provide compressibility and stretchability so that the hose may be flexed to follow a tight curve. Preferably, the adhesive layer is formed from material selected for bonding nylon and the material selected for the protective
15 layer, that is, nitrile rubber.

Preferably, the reinforcing layer is formed from cellulosic material, such as rayon, formed in to a braiding, and having a strength sufficient to accommodate the hoop stress resulting from the carriage of pressurised fluid.
20 Preferably, the finishing layer is formed from elastomer, such as nitrile rubber. In such form, the protective layer and the finishing layer may be formed from the same material. However, it is preferred that the materials selected for each layer be tailored to their particular purpose.

Preferably, the finishing layer is the outermost layer as the material selected does not require further protection. However, it will be appreciated that a further finishing layer may be applied for colouring or aesthetics if necessary, or a
5 metalizing layer may be applied for enhancing the reflectivity of the hose.

In order that the invention may be more readily understood and put into practical effect, a preferred embodiment of the present invention will now be described with
10 reference to the following drawing, and wherein:

Fig. 1 is a partially fragmented perspective view of flexible hose according to the invention.

A flexible hose 10 comprises five layers of different materials, each of which fulfils a different purpose. A core
15 layer 11 has a lumen 12 extending axially through the core to form a core wall 13 which is coaxial with the lumen and the remaining layers. The core layer is formed from nylon for prevention of permeation of refrigerant radially through the core wall.

20 An adhesive layer 14 is formed on an outer surface of the core layer to which a protective layer 15 is formed. The protective layer is formed from flexible, compressible and heat insulating material. A reinforcing layer 16 formed from rayon textile is provided in the form of a braid material onto

the outer resilient surface of the to provide an outer reinforced surface. In the particular example illustrated, the reinforcing layer is formed from 8-ply rayon to provide burst protection.

5 A finishing layer 17 formed onto the outer resilient surface of the braided reinforcing layer for protecting the reinforcing layer.

10 In use, flexible hose according to the invention may be installed in domestic air conditioning installations in the place of pipe or tubing according to the prior art, or to replace such prior art tubing. Moreover, domestic air conditioning installations previously found to be difficult or impossible may be successfully installed using flexible hose according to the present invention.

15 A prototype flexible hose according to the invention has been tested in experimental trials. When compared to traditional copper pipe used for domestic air conditioning piping, flexible hose according to the invention has been found to have the following advantages:

- 20 • does not kink, thereby substantially eliminating refrigerant flow restrictions
- does not perish externally

- does not break down, even with ozone-safe refrigerants
- has a protective inner lining to prevent contact with rubber or synthetic materials
- 5 • substantially eliminates moisture by condensation
- requires no lagging or covering
- is stronger, safer and easier to use
- requires no specialised tools or training
- eliminates toxic gasses produced in copper pipe
- 10 installation

It is further suggested that flexible hose according to the invention may be compared with traditional copper piping as follows:

- Copper piping systems have for a long time required
- 15 the use of specialised tools for the creation of "flaring" to allow the mechanical joining of copper to the compressor units of fridge and air conditioning units.

- o Flexible hose according to the invention does not require any onsite flaring as the material may bezz
- 20 manufactured to convenient specified lengths and the flare and retaining device is an integral component of the piping system.

- Flaring copper requires a degree of accuracy that cannot always be guaranteed to not leak refrigerants to the ozone.

- o All flaring of flexible hose according to the invention is controlled due to the exact nature of machined fittings that are integral with the piping system.

- Copper piping systems for refrigerant gases require expert soldering when joining copper products.

- o Flexible hose according to the invention can be joined in approximately half the time by the incorporation of specialised machined joiners that provide a simple and easy joining method which substantially eliminates leaks.

- Copper piping as a result of solder joining requires treatment to remove carbonising that occurs on the copper tubing as a result of soldering processes.

- o Flexible hose according to the invention does not require solder joints and as such does not need to have carbon deposits removed.

- Copper has requirement to be pressure tested after soldering, increasing the labour requirements.

- o Flexible hose according to the invention has a working pressure 3,450 kPa (500 psi) and burst pressure 13,790

kPa (2000 psi) and requires no pressure testing when installed to specifications.

- Copper piping for fridge or air-conditioning applications requires at least 3-4 tradesman (with specialised training) to route and install copper and taking up to 3 to 4 hours on average for larger installations.

- o Flexible nature of flexible hose according to the invention piping can be installed by as little as one person (no specialised training) in as fast as 10-15 mins.

10 • Copper piping systems for refrigerants are prone to kinking reducing the efficiency of cooling systems and increasing energy usage.

- o Flexible hose according to the invention does not kink and retains refrigerant flow volumes thus maintaining energy efficiency.

- Copper piping has limitations as to the bends that can be created due to the construction of the product which limits application abilities.

- o Flexible hose according to the invention has superior flexibility due to the construction of the piping material, thereby enabling much broader installation possibilities.

- Copper requires joining to bends and other fittings to turn sharp direction changes increasing cost and labour requirements.

- o Flexible hose according to the invention is able to
5 be routed through sharp bends without the need to use bends and joiners and with no kinking.

- Copper needs to be deburred prior to joining increasing the labour and skill requirements.

- o Flexible hose according to the invention needs no
10 deburring as the product comes ready to install and use.

- Copper requires cumbersome insulation to achieve thermal retention

- o Flexible hose according to the invention is self
insulating and retains thermal independence.

- o Insulated copper has an increased outer diameter
15 that consumes space and reduces application abilities.

- o Flexible hose according to the invention has a
smaller outer diameter increasing the scope of applications
available.

- o Insulation to copper piping can mask areas of
20 perforation to the refrigerant carrying lines.

- o Flexible hose according to the invention is readily able to be inspected ensuring safe and easy maintenance.

- Copper pricing fluctuates according to world mineral pricing.

5 o Flexible hose according to the invention pricing remains consistent.

- Warehousing for Copper packaging size large and bulky and cannot be stacked. Takes up more space in transit vehicles.

10 o Flexible hose according to the invention packaging is small and convenient at approximately 1/4 of the size of conventional copper packaging and can be stacked.

- Copper is easily damaged (kinks) and unusable when incorrectly handled.

15 o Flexible hose according to the invention does not kink and cannot be damaged as easily.

- Copper is easily wasted when cut to size so not all of the product is used.

20 o Flexible hose according to the invention is manufactured to convenient lengths that are ready to use with no need for off cuts and waste.

Although the invention has been described with reference to a specific example, it will be appreciated by persons skilled in the art that the invention may be embodied in other forms within the broad scope and ambit of the invention as
5 herein set forth and defined by the following claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Flexible hose including:

a core layer having a lumen extending axially therethrough and an outer surface, the core layer being formed
5 from flexible material suitable for contact with domestic air conditioning refrigerant fluids;

an adhesive layer formed onto the outer surface of the core layer is sufficient coverage to provide an adhesive layer;

10 a protective layer formed onto the adhesive layer, the protective layer being formed from flexible, compressible and heat insulating material and having an outer resilient surface;

a reinforcing layer formed from braided material onto the
15 outer resilient surface to provide an outer reinforced surface; and

a finishing layer formed onto the outer resilient surface for protecting the reinforcing layer and retaining same in place on the protective layer.

20 2. The flexible hose according to Claim 1, wherein the core layer is formed from nylon suited for contact with domestic air conditioning refrigerant.

3. The flexible hose according to Claim 1 or Claim 2, wherein the protective layer and the finishing layer are formed from rubber.

4. The flexible hose according to any one of the preceding
5 claims, wherein the reinforcing layer is formed from rayon formed in to a braiding.

5. The flexible hose substantially as hereinbefore described with reference to Fig. 1.

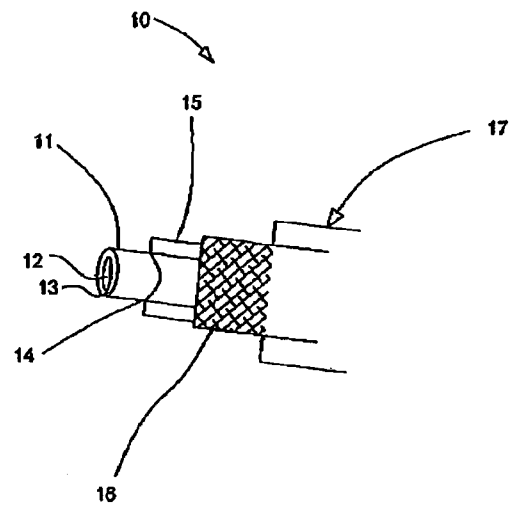


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2012/000139

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl.		
F16L 11/04 (2006.01)		
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)		
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 practicable, search terms used) EPODOC, WPI, IPC marks with keywords: flexible hose, heat, insulated, nylon, adhesive, lumen, protective and similar keywords. ESP@CENET, Google Scholar, Google Patents and Google with similar keywords as above.		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2004/0134553 A1 (ICHIMURA et al.) 15 July 2004 See whole document	1-4
A	US 6671162 B1 (CROUSE) 30 December 2003 See whole document	1-4
A	EP 959285 B1 (BRIDGESTONE CORPORATION) 11 September 2002 See whole document	1-4
☐ Further documents are listed in the continuation of Box C ☒ See patent family annex		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 20 March 2012		Date of mailing of the international search report 21 March 2012
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. +61 2 6283 7999		Authorized officer Avanthi Geedipally AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2806

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claim No.: 5
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
This claim does not comply with Rule 6.2(a) because it relies on references to the description and/or drawings.
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

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

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2012/000139

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
US	2004/0134553	EP 1433990 US 7000644	JP 2004211722 JP 2004211721
US	6671162	NONE	
EP	0959285	JP 11336956	
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			
END OF ANNEX			