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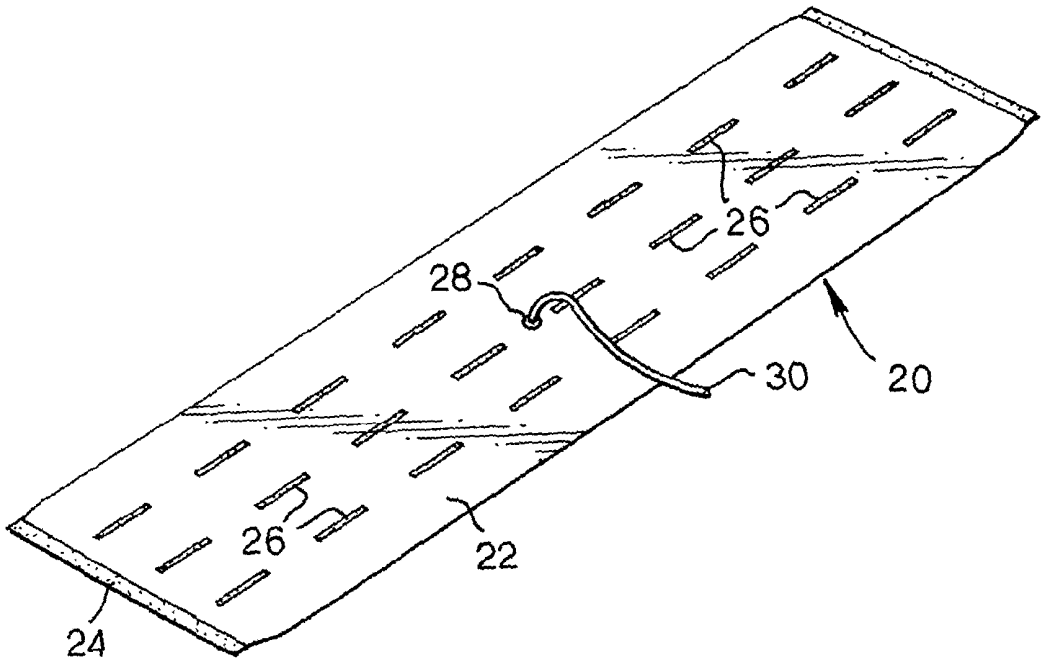
(54) Title: INFLATABLE SEAL



(57) Abstract: An inflatable seal (20) for closing an empty elongate duct, or for sealing cables as they pass out through a duct, is formed by welding two sheets (22,24) of polymeric laminate material together at their peripheries and also at a number of locations over their surfaces (26). An envelope thus produced has a plurality of generally elongate parallel tubes (27) in communication with each other, giving a contoured outer surface. When the envelope is rolled lengthwise over onto itself, the contouring provides mechanical interlocking, thereby resisting movement of the inflated seal along the duct.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INFLATABLE SEAL

This invention relates to an inflatable seal, and especially to an article for sealing a duct, or other aperture, which may or may not have an elongate member extending therefrom. The sealing provided by the invention finds particular, though not exclusive, application in sealing either an empty duct, or a duct that contains one or more electrical power or telecommunications cables.

For small size ducts, and for ducts that are substantially filled by one or more elongate substrates, sealing may be achieved by the introduction of an adhesive, which produces a bond of no significant thickness. However, as soon as a significant disparity in size or shape arises between the inner surface of the duct and the elongate substrates, or for large diameter empty ducts, then it is usual to introduce a sealing member to seal the duct against gas or liquid, for example moisture, passing therethrough. A duct may be sealed by a conformable sealing member, for example an O-ring, or by means of a mass of sealant or hot melt adhesive. However, in some circumstances voids may be left, or leak paths may occur, which would permit the ingress of moisture to a sensitive area, or in the case of a pressurised cable, loss of the pressurising fluid, for example.

EP-0152696-A discloses an expansible seal, in which a flexible envelope has a valve for receiving an expansible or expanding filler material therein. The envelope may be inserted into an empty duct and rolled over on to itself and inflated to fill the duct. When a substrate is present in the duct, the envelope can be wrapped around the substrate to fill the, usually annular, region between the substrate and the inner surface of the duct prior to inflation. Sealing is effected by an adhesive or sealant being interposed between the outer surface of the envelope and the duct, for example by being provided as a layer on the envelope. However, in certain circumstances, and in particular where the cross section or aperture of the duct to be sealed is comparatively large, difficulty can be experienced with retention of such an envelope in the duct.

Figure 1 shows an end view of a known inflatable sealing member 2 within a large duct 3 in a concrete wall 4. As shown, the duct 3 is empty of any substrates. The sealing member 2 is shown rolled over on to itself, and it can be seen that its outermost end 6 has been expanded to a significantly greater extent than its innermost end 8. Since the sealing member 2 is typically of a laminate construction, having an aluminium layer sandwiched between two polyethylene layers, such uneven inflation can result in cracking of the aluminium layer, whose function is to prevent, or at least minimise, escape of air from the inner member 2.

Figure 2 shows an elevation through the arrangement of Figure 1, and shows the effect of a net pressure P acting on one side of the sealing member 2. This can cause slippage of the layers that define the outer surfaces of the member, and could ultimately lead to the sealing member being forced entirely out of the duct, or could result in an opening therein.

Figure 3 shows a further problem that can arise, whereby under the effect of a net pressure P the surfaces of the sealing member 2 roll over one another, thus again jeopardising the sealing function.

In view of the potential problems that can arise as discussed with respect to Figures 1, 2 and 3, such inflatable sealing members are typically restricted for use in empty ducts that do not exceed a diameter of about 130 millimetre. It will be appreciated that the presence of one or more substrates in such a duct, however, or even in a larger duct, can result in the space that is required to be filled by the sealing member being reduced such that the difficulties set out above do not arise.

It will also be appreciated that by making a sealing member larger, so as to fill an empty duct more efficiently, the problems of slipping and rolling may be exacerbated. Furthermore, it will be appreciated that there is a limit to which the inflatable sealing member can be inflated so as not to produce undue stress on the material from which it is formed.

It is an object of the present invention to provide sealing of a duct that overcomes, or at least alleviates the known problems.

In accordance with one aspect of the present invention, there is provided a flexible envelope for sealing a duct, the envelope having an outer surface defined by two sheet

portions that overlie each other and that are secured to each other at a plurality of locations internally of the envelope to define a plurality of inflatable chambers in communication with each other, sealing means being provided on the outer surface to seal the envelope to the duct.

By securing the two sheet portions of the flexible envelope together internally, undesirable movements, such as those indicated in Figures 2 and 3, are resisted.

The chambers may be elongate and extend alongside, generally parallel, each other, being closed at each end, whereby the envelope is of generally rectangular configuration.

The chambers, at least after inflation of the envelope, preferably result in a contoured outer surface, so that overlapping portions can mechanically interlock so as to resist movement of the envelope along, i.e. into or out of, the duct.

It will thus be appreciated, that the enveloped may be rolled up onto itself, to seal an empty duct upon insertion thereinto, or rolled around a substrate lying in the duct, to effect sealing therebetween. The overlapping thus envisaged would extend to the envelope covering at least 360≥ of arc, and may be 720≥ or more. That is to say, the envelope may advantageously wrap around a substrate or onto itself more than once.

The sheet portions may be secured together by welding, or by bonding, for example with an adhesive. Furthermore, the locations at which the surfaces are secured together may conveniently extend along at least one substantially straight line, either continuously or discretely.

The sheet portions are joined together so as to define chambers that communicate with one another, thereby allowing the envelope to be inflated through a single inlet, a valve for example.

The envelope may be formed by sealing together two separate sheets around their periphery, or from folding a single sheet over and sealing it peripherally, or by providing it as a single tubular member.

Advantageously, the envelope is formed as a laminated construction, containing an intermediate layer that is substantially impervious to the transmission of, for example, air or moisture therethrough.

It will be appreciated that the envelope of the invention may be inserted into an empty duct, rolled over onto itself, and inflated in situ. Alternatively, the envelope may be wrapped around one or more elongate substrates, for example cables, that extend through and from the duct, so as to fill the generally annular space between the substrates and the inner wall of the duct.

GB-A-1 223 605 discloses a sealing device for providing a seal between two surfaces which are substantially parallel to each other. The device finds application as an elongate gasket secured to a frame around an opening in a furnace, the door of which closes onto the gasket. The gasket is inflatable and consists of two discrete chambers one wholly contained within the other, which need to be inflated separately. Sealing of the door to the frame of the chamber is achieved either by having the pressures in the two chambers the same, or by having the pressure in the outer chamber greater than that in the inner chamber. The seal is broken by arranging for the pressure in the inner chamber to exceed that in the outer chamber.

A flexible envelope for sealing a duct, in accordance with the present invention, will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 4 is an isometric view of the envelope prior to inflation;
Figure 5 is a view of the envelope of Figure 4 after having been inflated;
Figure 6 is a cross section along the line AA of Figure 5; and
Figure 7 shows the envelope of Figure 4 mounted in an empty duct.

Referring to Figures 4, 5 and 6, a flexible envelope 20 has an outer surface defined by an upper sheet portion 22 and a lower sheet portion 24. The sheet portions 22, 24 are welded together along their periphery so as to close the envelope 20. Three sets of short linear welds 26 are made so as to secure the sheets 22 and 24 to each other at a plurality of locations over their surfaces within the periphery, whilst leaving all of the chambers 27 thereby defined within the envelope 20 in communication with each other.

A one-way valve 28 is fitted into the upper sheet portion 22 and a tube 30 extends therefrom to an inflation device (not shown) for introducing pressurised air into the envelope 20.

Each sheet 22 and 24 is formed as a laminate of three layers, with an intermediate layer of aluminium sandwiched between two layers of polyethylene. It will be appreciated that the layers are arranged to be flexible so as to allow the envelope 20 to be inflated into the configuration shown in Figure 5 through the tube 30 and valve 28. In practice, however, it will be appreciated that inflation will usually not be effected until after the envelope 2 has been located within the duct that is to be sealed.

In order to ensure that the envelope 20 is sealed to the inner surface of a duct, and also to the outer surface of any substrate around which it is wrapped, one or both of the sheet portions 22 and 24 will be coated with an adhesive or mastic, or such a sealing component may be provided, either attached to the envelope 20 or separately therefrom, around only part of its length.

It will be appreciated that the envelope 20 may be rolled over on to itself and inserted into a duct in the manner shown in Figure 1, with the voids between the sealing member and the duct wall being filled by the sealing material. It is also understood that the sealing member or envelope may be wrapped around and/or between one or more substrates so as to provide sealing therearound as they emerge from a duct.

Figure 6 also illustrates that the size of the chambers 27 are limited, in this case to a maximum diameter, so that undue stretching of the wall material thereof is prevented. Furthermore, it will be appreciated that rolling motion of the envelope 20 in the direction of the arrow B is not possible, due to the presence of the welds 26, which allow mechanical interlocking of overlapping portions of the contoured envelope.

Figure 7 is a view of the envelope 20 when overlapped on itself so as to seal an empty duct 32. The forces acting thereon are indicated by the arrows, from which it can be seen that this configuration is self-stabilizing, in contrast to the inherently unstable configuration of the known envelope 2 as shown in Figure 2.

Claims

1. A flexible envelope for sealing a duct, the envelope having an outer surface defined by two sheet portions that overlie each other and that are secured to each other at a plurality of locations internally of the envelope to define a plurality of inflatable chambers in communication with each other, sealing means being provided on the outer surface to seal the envelope to the duct.

2. An envelope according to claim 1, wherein the securement of the sheet portions to each other is effected by welding the sheet portions together.

3. An envelope according to claim 1, wherein the securement of the sheet portions to each other is effected by bonding, preferably by the formation of adhesive bonds.

4. An envelope according to any of the preceding claims, wherein the securement locations extend along at least one substantially straight line.

5. An envelope according to claim 4, wherein the securement locations extend discretely along said at least one line.

6. An envelope according to any one of the preceding claims, wherein the two sheet portions are formed from separate sheets that are sealed together peripherally.

7. An envelope according to any one of claims 1 to 5, wherein the two sheet portions are formed from a single sheet that is folded over and sealed peripherally.

8. An envelope according to any one of claims 1 to 5, wherein the two sheet portions are formed from a single tubular member.

9. An envelope according to any one of the preceding claims, wherein each sheet portion is of laminate construction.

10. An envelope according to claim 9, wherein the laminate comprises metallised polymeric material.

11. An envelope according to any one of the preceding claims, of generally rectangular configuration.

12. An envelope according to any one of the preceding claims, wherein the sealing means comprises a layer of mastic or adhesive.

13. An envelope according to any one of the preceding claims, wherein the sealing means comprises elastic material.

14. A duct sealed by an inflated envelope in accordance with any one of the preceding claims being inserted therein.

15. A duct according to claim 14 having at least one elongate member extending therefrom, and wherein the envelope seals the or each elongate member into the duct, and the sealing means seals the envelope to the or each elongate member.

16. A duct according to claim 14 or 15, wherein the envelope is wrapped over onto itself with the inflated chambers thereof interlocking thereby to resist movement of the envelope along the duct.

17. A method of sealing a duct, wherein an envelope according to any one of claims 1 to 13 is inserted into the duct and inflated into sealing contact therewith.

18. A method according to claim 17, wherein the duct has at least one elongate member extending therefrom and the envelope is positioned to seal the or each member within the duct.

19. A method according to claim 17 or 18, wherein the envelope is wrapped around onto itself.

Fig.1.

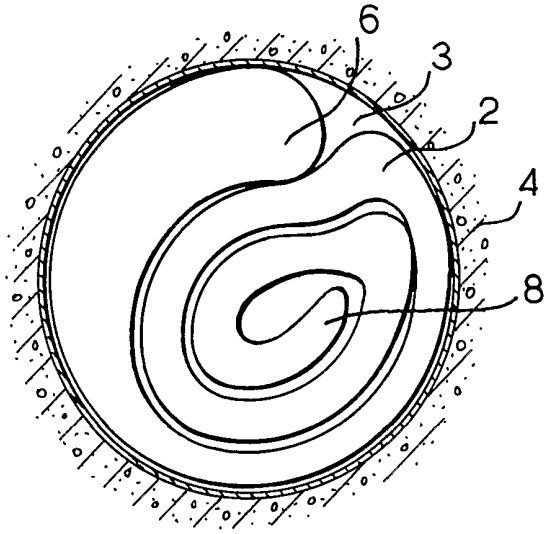


Fig.2.

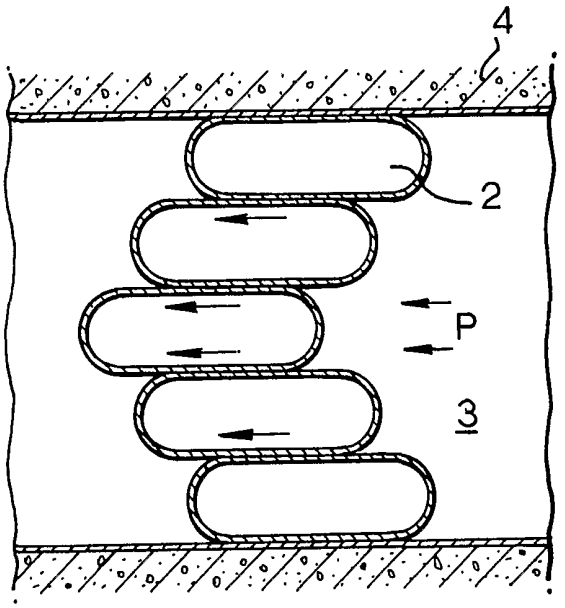


Fig.3.

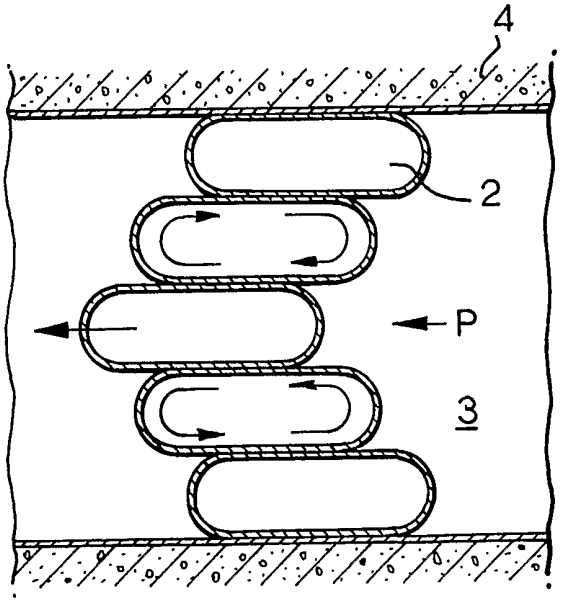


Fig.4.

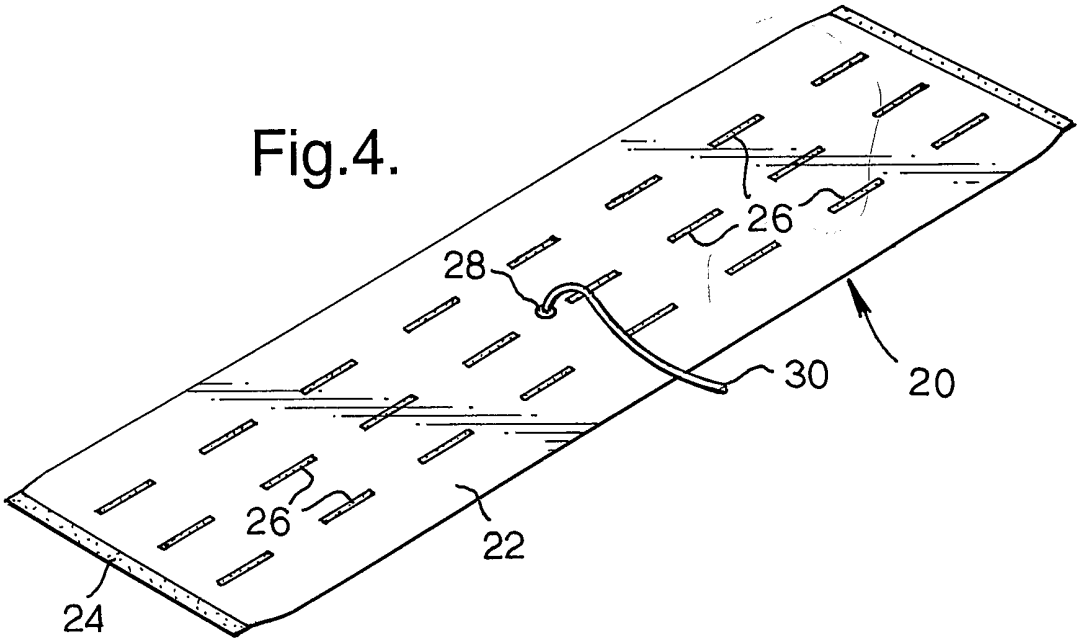


Fig.5.

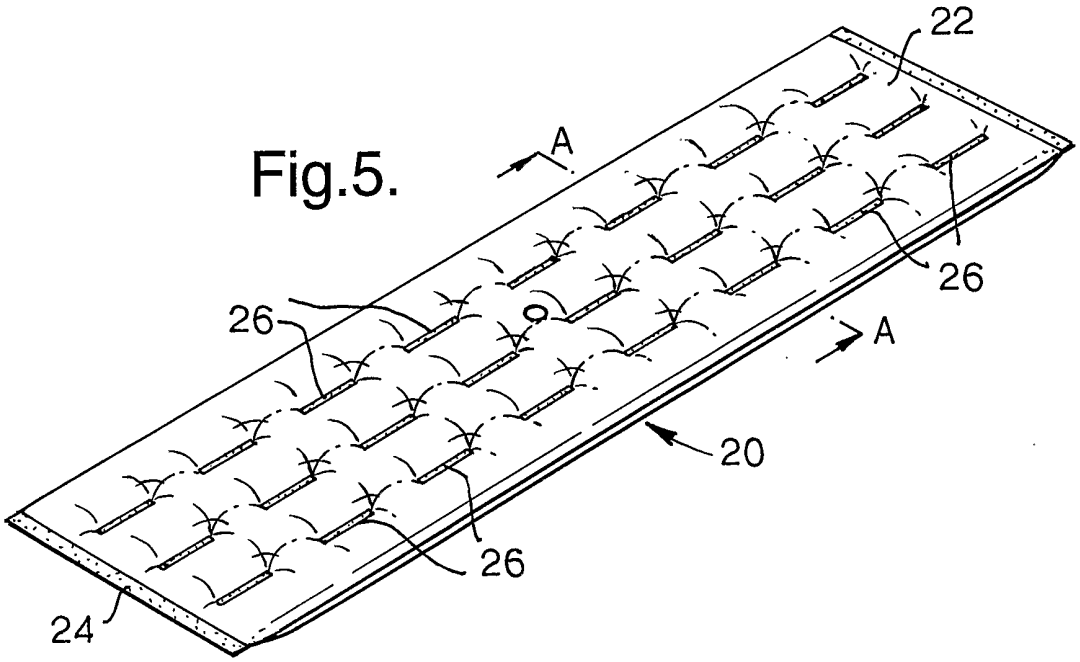


Fig.6.

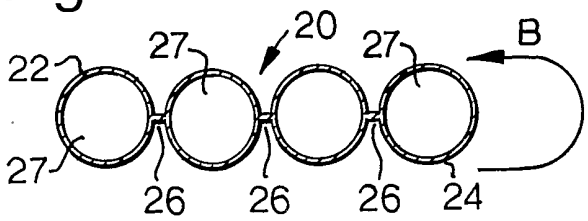
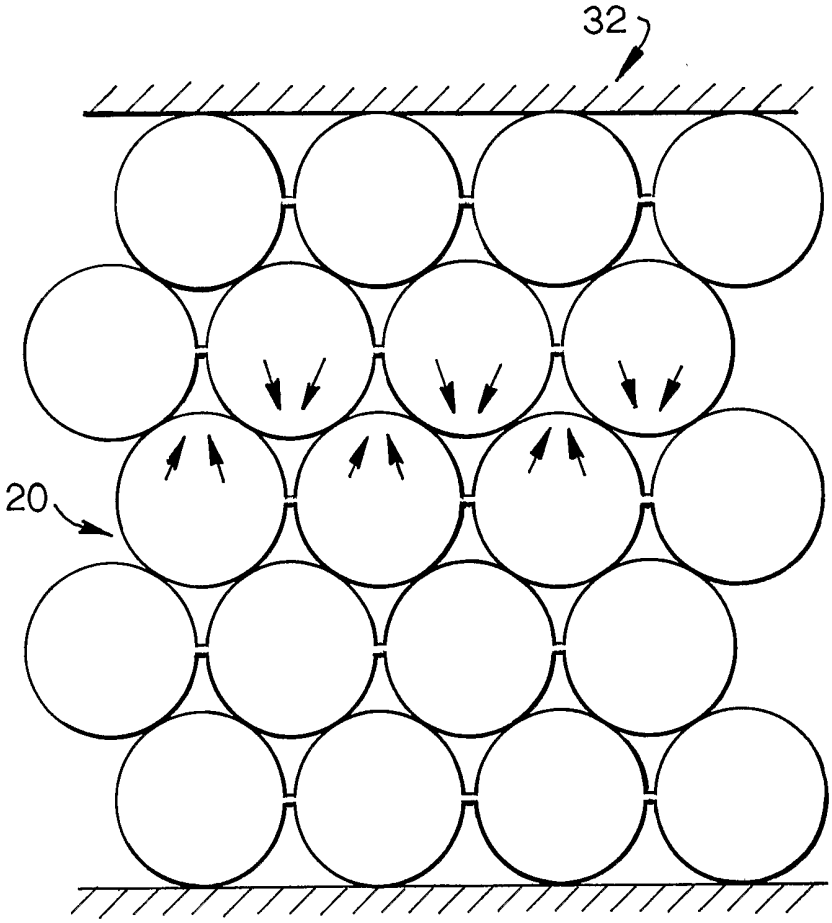


Fig.7.



INTERNATIONAL SEARCH REPORT

Interna Application No
PCT/GB 01/03769

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16L55/128 F16L55/132

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 F16L

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 056 012 A (M. KURUKULASURIYA) 11 March 1981 (1981-03-11) page 1, line 1-21; figure 1	1,14,17
A	EP 0 377 141 A (G. KEMPKEN) 11 July 1990 (1990-07-11) claims 1-8; figures 1,2	1,14,17
A	DE 24 57 412 A (I. JESCHKE) 10 June 1976 (1976-06-10) claims 1-4; figures 1,2	1,14,17
A	WO 00 47928 A (PIPE SYSTEMS LTD) 17 August 2000 (2000-08-17) abstract; figure 1	1,14,17

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

☒ Patent family members are listed in annex.

° Special categories of cited documents:

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"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	Date of mailing of the international search report
8 November 2001	16/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Angius, P

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internal Application No
PCT/GB 01/03769

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
GB 2056012	A	11-03-1981	NONE		
EP 377141	A	11-07-1990	DE	3900025 A1	05-07-1990
			EP	0377141 A2	11-07-1990
DE 2457412	A	10-06-1976	DE	2457412 A1	10-06-1976
WO 0047928	A	17-08-2000	AU	2448000 A	29-08-2000
			WO	0047928 A1	17-08-2000