



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : E01B 9/60, 9/62	A1	(11) International Publication Number: WO 99/63160 (43) International Publication Date: 9 December 1999 (09.12.99)
(21) International Application Number: PCT/GB99/01705 (22) International Filing Date: 28 May 1999 (28.05.99) (30) Priority Data: 9811591.8 30 May 1998 (30.05.98) GB (71)(72) Applicant and Inventor: PENNY, Charles [GB/GB]; 27 Victoria Park Road, Malvern, Worcestershire WR14 2JX (GB). (74) Agents: FEAKINS, Graham, Allan et al.; Raworth Moss & Cook, 36 Sydenham Road, Croydon, Surrey CR0 2EF (GB).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published With international search report. With amended claims.
(54) Title: RAILWAY OR TRAMWAY RAIL AND RAIL FASTENING SYSTEM		
(57) Abstract A railway or tramway rail fastening system includes a shell (2) and a resilient fill (4) within the shell for holding a rail (1), the shell having an inner profile open channel form to receive the rail, the inner profile being shaped to hold firmly, through the fill (4), the head and base region and/or an intermediate portion of the rail. The arrangement is such that pinch points are produced which hold the rail in place.		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

RAILWAY OR TRAMWAY RAIL AND RAIL FASTENING SYSTEM

This invention relates to a railway or tramway rail fastening system including a rail and a shell for holding a railway or tramway rail.

5 According to one aspect of the present invention, there is provided a railway or tramway rail fastening system, comprising a shell and a resilient fill within the shell for holding a railway or tramway rail having a head, a web and a base region, and the shell having an inner profile of open channel form to
10 receive the rail; characterised in that the inner profile of the shell at its upper, open side and at its lower, base side is shaped to hold firmly, through the fill, the head and base region, respectively, of the rail.

15 The inner profile of the shell between its base and the open side is preferably narrowed so as to form a detent or pinch point through which the base region of the rail has to be passed upon insertion of the rail into the shell to retain the rail.

20 According to a second aspect of the present invention, there is provided a railway or tramway rail fastening system, comprising a shell and a resilient fill within the shell for holding a railway or tramway rail of substantially symmetrical form having head and base portions joined by an intermediate
25 portion of greater girth; characterised in that the shell has an inner profile of open channel form to receive the rail and the inner profile of the shell intermediate its upper, open side and its lower, base side being shaped to hold firmly, through the fill, the intermediate portion of the rail.

30 The fill can be of stiff and strong but resilient material such as an elastomer. The fill can be bonded to the shell and/or to the rail or can be provided as a sheet for forcing into the shell upon insertion of the rail or can be poured, cast or
35 sprayed into the space between the shell and rail.

-2-

The inner profile of the shell can be straight or curved in the lengthwise direction thereof to match a given longitudinal or vertical straightness or curvature respectively of the rail to be held in the shell.

5

The inner profile of the shell can be pre-profiled to match the given longitudinal straightness or curvature of the rail to be held in the shell. This pre-profiling can be achieved by applying bending forces to the shell, which forces can be applied within the inner profile and/or against the exterior of the shell.

10

The material of the shell is preferably stiffer than the elastomer inside it and can be of sheet material or pulltruded, extruded, moulded or cast, for example of polymer concrete, sheet metal, fibre-reinforced thermosetting resin or of fibre-reinforced thermoplastics.

15

The rail itself could be used to provide the required support and bending forces to the shell. Alternatively, individual formers, e.g. short lengths of rail or rail profiled material, can be located inside and/or outside of the shell to provide the required bending forces and alignment during installation.

20

25

Preferably, the shell is laid and/or set in a supporting bed or slab of, for example, concrete or asphalt.

A railway or tramway track will comprise two such shells located side-by-side and can be formed as a unified slab construction. Alternatively, the two shells can have a tie piece between them.

30

According to a third aspect of the present invention, there is provided a railway or tramway rail fastening system including at least one shell with resilient fill, the or each shell being essentially as defined according to the first or second aspect

35

-3-

of the invention and the or each shell having a rail held firmly therein by the combination of fill and shell.

5 The rail may be substantially symmetrical in cross section so that when its head becomes worn the rail can be removed from the shell, inverted and replaced in the shell to provide a second head for use. The two rails of a track can also be changed over one for the other.

10 According to a fourth aspect of the present invention, there is provided a method of laying a railway or tramway rail using a shell with resilient fill essentially as defined according to the first or second aspect of the invention and causing a rail to be held firmly therein, the rail being held securely in
15 position by the combination of fill and shell.

20 According to a fifth aspect of the present invention, there is provided a railway or tramway rail, the rail having a longitudinal profile including a bulged portion when viewed in cross-section, said bulged portion acting as a detent when inserted into a surrounding fastening system essentially as defined according to the first or second aspect of the invention to hold the rail in place.

25 The bulged portion may be in intermediate upper and lower regions of the rail or the bulged portion may be in a lower and/or upper region of the rail. This enables ease of rail replacement with minimum disruption to the remainder of the system.

30 The overall cross-section of the rail maybe substantially rectangular and the sides of the rail maybe provided with not just one bulged portion but two or three bulged portions, extending from the head of the rail towards its base, so as to
35 provide a ribbed formation along the sides of the rail. With such a configuration, a webless and/or footless rail is effectively produced, thereby allowing more side wear allowance

-4-

and less frequent rail change, whilst reducing corrosion sensitivity and stresses within the rail.

5 This comparatively simple cross-section with no web allows ultrasonic testing of the whole rail in a satisfactory manner and not just the head of the rail as at present. This is intended to avoid checking delays by identifying flaws before they cause an unplanned delay.

10 Such a cross-section is also intended to reduce sensitivity to inherent or load-generated defects or manufacturing defects such as inclusions and fractures. In addition, the comparatively wide head provides a greater bearing area for the wheel and the wider, and therefore more solid, webless cross-section permits
15 sliding expansion joints to be more robust.

Finally, it is well known that noise is generated by passage of the trains on webbed rails and with the proposed cross-section, the webless rail is expected significantly to reduce
20 noise output.

In all cases, the shell can be split if required in the region of its base to enable insertion below an existing rail.

25 In a further development, at least one seal in the form of an elastomeric strip may be wedged between the shell and the rail in a region where there is no fill in order to give further support to the rail.

30 For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made by way of example, to the accompanying drawings, in which:

Figure 1 is a diagrammatic sectional view of a railway or
35 tramway fastening system,

-5-

Figure 2 is a view similar to Figure 1 showing a shell with its fill in accordance with the second aspect of the invention defined above,

5 Figure 3 is a diagrammatic sectional view of another profile which the shell can take to accommodate a modified flanged rail,

10 Figures 4, 5 and 6 are diagrammatic sectional views illustrating three possible approaches to the supply and manufacture of the system, and

Figure 7 is a diagrammatic sectional view of a preferred profile of rail to be received in the shell of Figure 2, and

15 Figures 8 and 9 are views similar to Figure 2 showing two further possible profiles of rail and shell.

20 Figure 1 shows, by way of example, a railway rail 1 held in a shell 2 set in a bed or slab 3 of concrete. The shell 2 has an inner profile of open channel form to receive the rail 1 and the inner profile of the shell at its upper, open side and at its lower, base side being shaped to hold firmly through the intermediary of a resilient fill 4 the head 1A and base region 1B of the rail 1.

25 The inner profile of the shell 2 between its base and its open side is narrowed so that the inner profile of the resilient fill at 5 forms a pinch point through which the base 1B has to be passed upon insertion of the rail 1 into the shell 2. This narrowing means that the rail 1 must be effectively sprung into the shell as a type of snap-action/detent effect. Removal of the rail for replacement or inversion requires a similar spring snap-action to be overcome. As Figure 1 shows, the rail 1 is substantially symmetrical to allow for such inversion.

35 It will be noted that one wall 2A is lower than the other wall 2B to allow for the passage of the flange of a wheel of a

-6-

railed vehicle, whilst maintaining support for the head 1A of the rail on both sides.

5 The lengthwise profile of the shell 2 is arranged to follow the longitudinal profile of the rail to be laid therein, whether the rail is straight or curves in horizontal and/or vertical planes.

10 The required profile of the shell 2 can be achieved in a number of ways. For example, a shell 2 containing its layer of fill 4 can be taken and set to the correct curve (and cant in the case of a track with parallel rails) using inserts in the form of short lengths of rail or wood, for example, of the same profile as the final rail. The inserts such as the dummy rail
15 pieces can have rods connected to them so that the inserts can be twisted, for example, to achieve the desired curvature of the shell or can be raised or lowered for vertical and horizontal alignment.

20 The material of the shell 2 is thereby twisted and the surrounding concrete material 3 is then poured and allowed to set, thereby maintaining the shell in its formed alignment profile. Protrusions 6 can be provided to ensure bonding of the shell with the concrete and so that the shell 2 can be gripped
25 externally by temporary lifting grips (not shown) engaging with the protrusions 6 so that the pre-profiled shell can be moved to the location where it is to be incorporated in the concrete. To enhance bonding of the shell to surrounding concrete and/or the shell to the elastomer fill, the shell surface(s) can be given
30 a roughened texture.

35 Another possibility would be to apply external bending forces to the shell 2 to achieve the required profile and level of cant, in which case the fill 4 can be provided later inside the shell.

-7-

This system lends itself to the formation of either slip-formed, in situ, or precast slab track, where for example slabs of concrete five metres long are manufactured and incorporate parallel shells 2, which are then taken to site and the rails are inserted after installation of the slabs. The rails could be inserted at the point of manufacture if an economic length can be transported.

On site, the rails can be welded together, dowels or other joiners can be used to join the pre-cast slabs accurately and grout holes or grout "tubes á manchete" can be made in the slab to provide vertical alignment adjustment during installation and/or operation.

For railway track replacement, where at present ballasted track is in place, where there is for example a 600mm depth of ballast, the top 300mm of ballast could be taken out and could be recycled, with even the concrete sleepers being crushed to provide concrete for its slab track or to form a firm bed and the slab track as described above could be laid on top of the crushed concrete.

The regions 7 in Figure 1 either side of the web of the rail could be part of the solid steel rail or could be filled with rubber or another polymer material which can be but need not be bonded to the rail and/or shell.

It will be appreciated that with the present system the rail is physically squeezed into the shell and is sprung into place, whilst the head 1A is held and at the same time resilience offered to the rail is maintained to its base 1B, there being a constant and even base region area which is resiliently supported by the shell itself. The thickness of the elastomer can be controlled to give the correct resilience at all locations whilst keeping resilient material costs to a minimum. The shells 2 of a track form barriers to spurious electrical connection between the rails and a good rough surface and positive mechanical

-8-

interlocking can be provided where appropriate to ensure good concrete/shell bond and shell/elastomer bond.

Figure 2 illustrates a variation in the profile of the shell 2 and fill 4 to receive a reversible rail of the form shown in Figure 7 which has identical head and base regions 1A, 1B joined by an intermediate bulged portion 1C. Accordingly, the portions 2A and 4A of the shell and fill, respectively, intermediate the open end and the lower, base side of the shell are correspondingly bulged or flared.

The rail of Figure 7 is therefore snapped into position, the central bulged portion 1C having overcome the restraint of the entry into the shell at its open end.

The actual rail illustrated in Figure 2 is of the same form as that shown in Figure 1, to illustrate the point that both profiles of rail can be accepted by this particular profile of shell and fill with the rail still being satisfactorily held firmly in place.

Figure 3 illustrates a different form of shell with its fill of elastomeric material and shaped to accommodate a flanged rail with the flange and web being illustrated at 1B and 1C. Since the shell and its polymer provide adequate support and resilience for the rail along the whole of the underside of the flange 1B, the flange is not so wide as would normally be the case with conventional railway rail only supported on sleepers.

Figure 4 diagrammatically illustrates how the system can be pre-manufactured and delivered to site ready for setting down. Here, the shell 2 is delivered with its fill 4 already encasing the rail 1.

Figure 5 illustrates the rail 1 with the layer of fill 4 already bonded to it. In this case, the shell 2 is already cast

-9-

in its concrete base or slab and the rail with its fill coating is forced into the pre-aligned shell.

Figure 6 shows that the fill 4 can be initially bonded to the inner profile of the shell 2 and then can be delivered to site for subsequent rail insertion.

Reverting to Figure 7, the profile of rail illustrated there can also be the profile utilised, along with the shells, in the variations illustrated in Figures 4, 5 and 6.

In practice, the shell 2 can be set in the concrete either by pre-alignment as described earlier, with the concrete poured about the shell or the concrete can be poured and the shell can be vibrated down in it.

The fill 4 can be poured or otherwise coated and bonded on the shell and/or rail or it could be in the form of, for example, a rubber sheet which can be arranged to straddle the open side of the shell and be forced into the shell at the time of insertion of the rail.

Figures 8 and 9 illustrate profiles of rail which are developed from the cross-section of rail illustrated in Figure 7.

It will be noted that both the more squat form of rail shown in Figure 8 and the form of rail shown in Figure 9 are provided with ribbed configurations along their sides, into which can be fitted one or more profiled elastomeric gaskets or seals 8 in order to give further support to the rail.

The method of assembly in this case could follow the steps of providing the shell 2, dropping the elastomeric base fill 4 into the base of the shell 2, dropping/forcing the rail 1 onto the fill 4 and inserting the seals 8, firstly by inserting one profiled seal 8 on one side of the rail, then pulling the rail

-10-

sideways to compress that seal 8 to allow space for insertion of the second seal 8 finally releasing the rail which then achieves the desired position.

5 The present system has the benefits of easy installation and easy replacement with no loose fittings thereby requiring little inspection as compared with conventional railway track. It has a higher performance, not least in holding the head of the rail steady, whilst maintaining the required vertical resilience up
10 and down and laterally, reducing noise pollution and enhancing safety. It permits automatic rerailing in the event of derailment, nominal inspection, maintenance or faults to reduce delays to traffic.

15 The reversible rail has the benefit of cost, time and material savings.

 Regarding the elastomer fill 4, the thickness of it can be controlled to give correct vertical and lateral resilience at all
20 locations whilst keeping material costs to the minimum and the shell provides a barrier to highly alkaline concrete which will serve to protect the elastomer. The shell 2 also serves to protect the elastomer during shipping and handling and also provides protection against the forces required to align the
25 rail, e.g. when the system is gripped by utilising the shell which accordingly avoids gripping or compressing the elastomer fill 4.

 The whole system in its various forms can also be used for
30 tramway rail.

CLAIMS

1. A railway or tramway rail fastening system, comprising a shell (2) and a resilient fill (4) within the shell (2) for holding a railway or tramway rail (1) having a head (1A), a web (1C) and a base region and the shell having an inner profile of open channel form to receive the rail; characterised in that the inner profile of the shell (2) at its upper, open side and at its lower, base side is shaped to hold firmly, through the fill (4) the head and base region (1A, 1B), respectively, of the rail (1).

2. A system according to claim 1, wherein the inner profile of the shell (2) between its base and the open side is narrowed so as to form a detent or pinch point through which the base region (1B) of the rail (1) has to be passed upon insertion of the rail into the shell to retain the rail.

3. A railway or tramway rail fastening system, comprising a shell (2) and a resilient fill (4) within the shell for holding a railway or tramway rail (1) of substantially symmetrical form having head and base portions joined by an intermediate portion (1C) of greater girth; characterised in that the shell (2) has an inner profile of open channel form to receive the rail (1) and the inner profile of the shell intermediate its upper, open side and its lower, base side being shaped to hold firmly through the fill (4), the intermediate portion (1C) of the rail.

4. A system according to claim 1, 2 or 3, wherein the fill (4) is an elastomer.

5. A system according to any one of the preceding claims, wherein the fill (4) is bonded to the shell (2) and/or the rail (1).

6. A system according to any one of claims 1 to 4, wherein the fill (4) is sheet material.

-12-

7. A system according to any one of the preceding claims, wherein the inner profile of the shell (2) is pre-profiled to match the given longitudinal straightness or curvature of the rail (1) to be held in the shell.

5

8. A system according to any one of the preceding claims, wherein the material of the shell is stiffer than the fill (4) and has been formed out of sheet material, by pulltruding, extrusion, moulding or by casting.

10

9. A railway or tramway rail fastening system including at least one shell (2) with resilient fill (4), the or each shell being formed according to any one of the preceding claims and the or each shell having a rail (1) held firmly therein by the combination of fill (4) and shell.

15

10. A system according to claim 9, wherein the rail is substantially symmetrical in cross-section.

20

11. A method of laying a railway or tramway rail (1) using the shell (2) with resilient fill (4) according to any one of the preceding claims and causing a rail (1) to be firmly held therein, the rail being held securely in position by the combination of fill and shell.

25

12. A method according to claim 11 and further comprising inserting at least one elastomeric, profiled seal (8) between the rail (1) and shell (2) in a region where there is no fill (4).

30

13. A railway or tramway rail, the rail having a longitudinal profile including a bulged portion when viewed in cross-section, said bulged portion acting as a detent when inserted into a surrounding fastening system according to any one of claims 1 to 10 to hold the rail in place.

35

14. A rail according to claim 13, wherein the bulged portion is in intermediate upper and lower regions of the rail

-13-

or is in a lower and/or upper region of the rail.

15. A rail according to claim 13 or 14, that is substantially rectangular in cross-section.

AMENDED CLAIMS

[received by the International Bureau on 15 November 1999 (15.11.99); original claims 1, 2, and 3 replaced by new claims 1 and 2; original claims 4-6 and 12-15 amended; and renumbered as claims 3-5 and 11-14; original claims 7-10 renumbered as claims 6-9 (3 pages)]

1. A railway or tramway rail fastening system, comprising a shell (2) and a resilient fill (4) within the shell (2) for holding a railway or tramway rail (1) having a head (1A), a web (1C) and a base region and the shell having an inner profile of open channel form to receive the rail, the inner profile of the shell (2) at its upper, open side and at its lower, base side being shaped to hold firmly, through the fill (4) the head and base region (1A, 1B), respectively, of the rail (1); characterised in that the inner profile of the shell (2) between its base and the open side is narrowed so as to form a detent or pinch point through which a region of the rail (1) has to be passed upon insertion of the rail into the shell to retain the rail.

2. A railway or tramway rail fastening system, comprising a shell (2) and a resilient fill (4) within the shell for holding a railway or tramway rail (1) of substantially symmetrical form having head and base portions joined by an intermediate portion (1C) of greater girth, the shell (2) having an inner profile of open channel form to receive the rail (1) and the inner profile of the shell intermediate its upper, open side and its lower, base side being shaped to hold firmly through the fill (4), the intermediate portion (1C) of the rail; characterised in that the inner profile of the shell (2) between its base and the open side is narrowed so as to form a detent or pinch point through which a region of the rail (1) has to be passed upon insertion of the rail into the shell to retain the rail.

3. A system according to claim 1 or 2, wherein the fill (4) is an elastomer.

4. A system according to claim 1, 2 or 3, wherein the fill (4) is bonded to the shell (2) and/or the rail (1).

5. A system according to any one of claims 1 to 3, wherein the fill (4) is sheet material.

6. A system according to any one of the preceding claims, wherein the inner profile of the shell (2) is pre-profiled to match the given longitudinal straightness or curvature of the rail (1) to be held in the shell.

7. A system according to any one of the preceding claims, wherein the material of the shell is stiffer than the fill (4) and has been formed out of sheet material, by pulltruding, extrusion, moulding or by casting.

8. A railway or tramway rail fastening system including at least one shell (2) with resilient fill (4), the or each shell being formed according to any one of the preceding claims and the or each shell having a rail (1) held firmly therein by the combination of fill (4) and shell.

9. A system according to claim 9, wherein the rail is substantially symmetrical in cross-section.

10. A method of laying a railway or tramway rail (1) using the shell (2) with resilient fill (4) according to any one of the preceding claims and causing a rail (1) to be firmly held therein, the rail being held securely in position by the combination of fill and shell.

11. A method according to claim 10 and further comprising inserting at least one elastomeric, profiled seal (8) between the rail (1) and shell (2) in a region where there is no fill (4).

12. A railway or tramway rail, the rail having a longitudinal profile including a bulged portion when viewed in cross-section, said bulged portion acting as a detent that co-operates with the detent of the shell (2) when inserted into the surrounding fastening system according to any one of claims 1 to 9 to hold the rail in place.

13. A rail according to claim 12, wherein the bulged portion is in intermediate upper and lower regions of the rail or is in a lower and/or upper region of the rail.

14. A rail according to claim 12 or 13, that is substantially rectangular in cross-section.

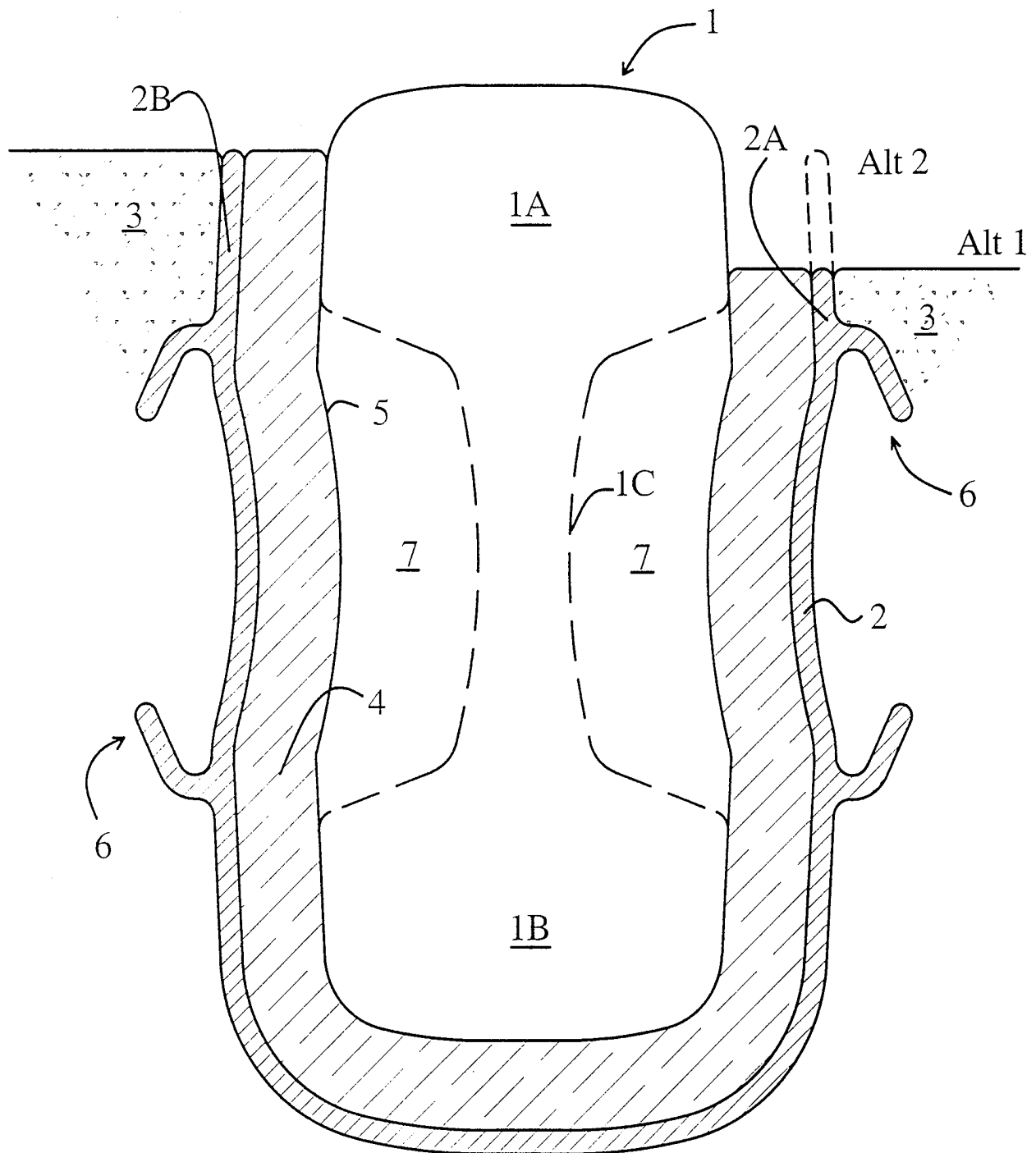


FIG. 1

SUBSTITUTE SHEET (RULE 26)

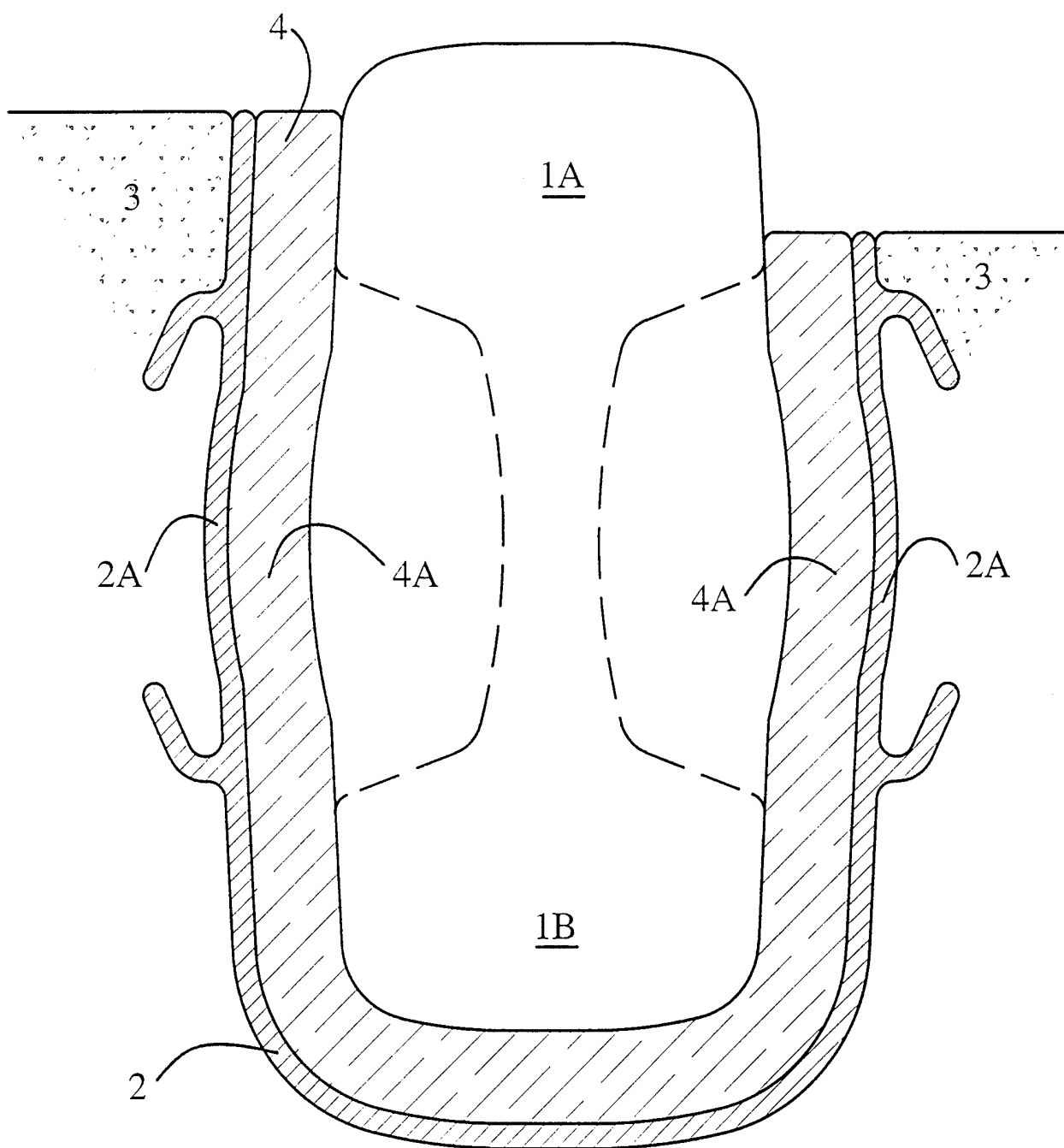


FIG. 2

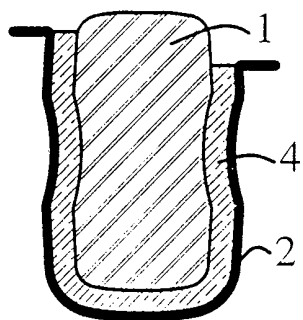


FIG. 4

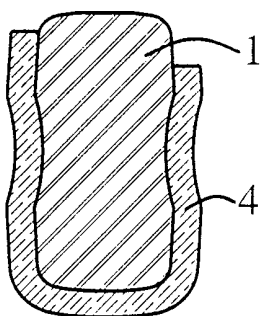


FIG. 5

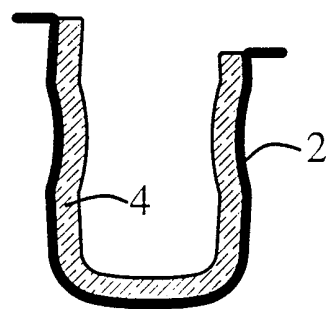


FIG. 6

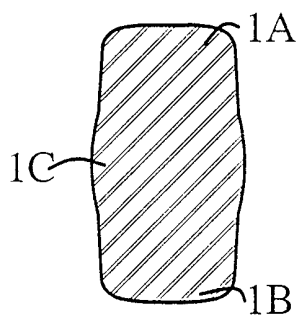


FIG. 7

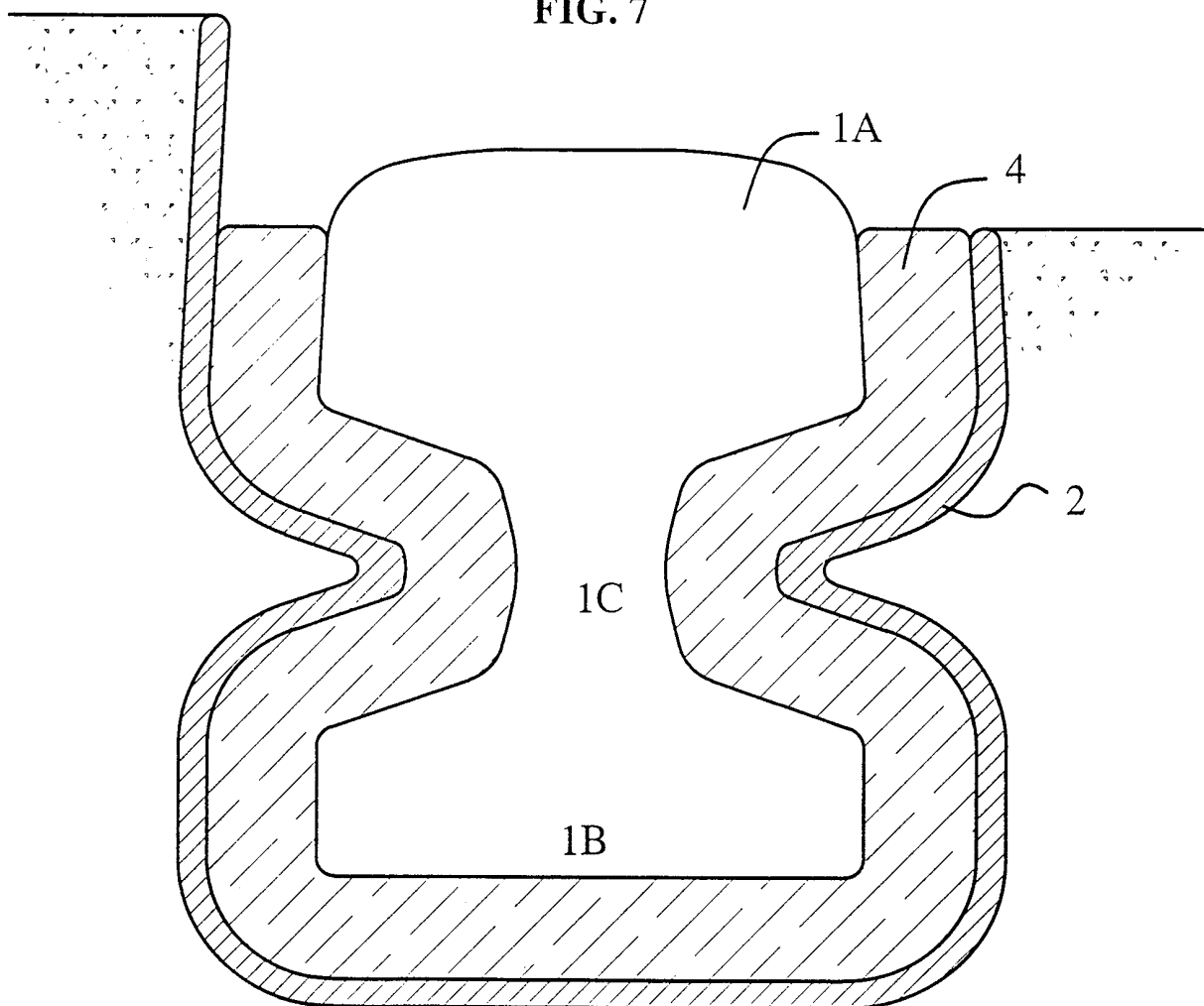


FIG. 3

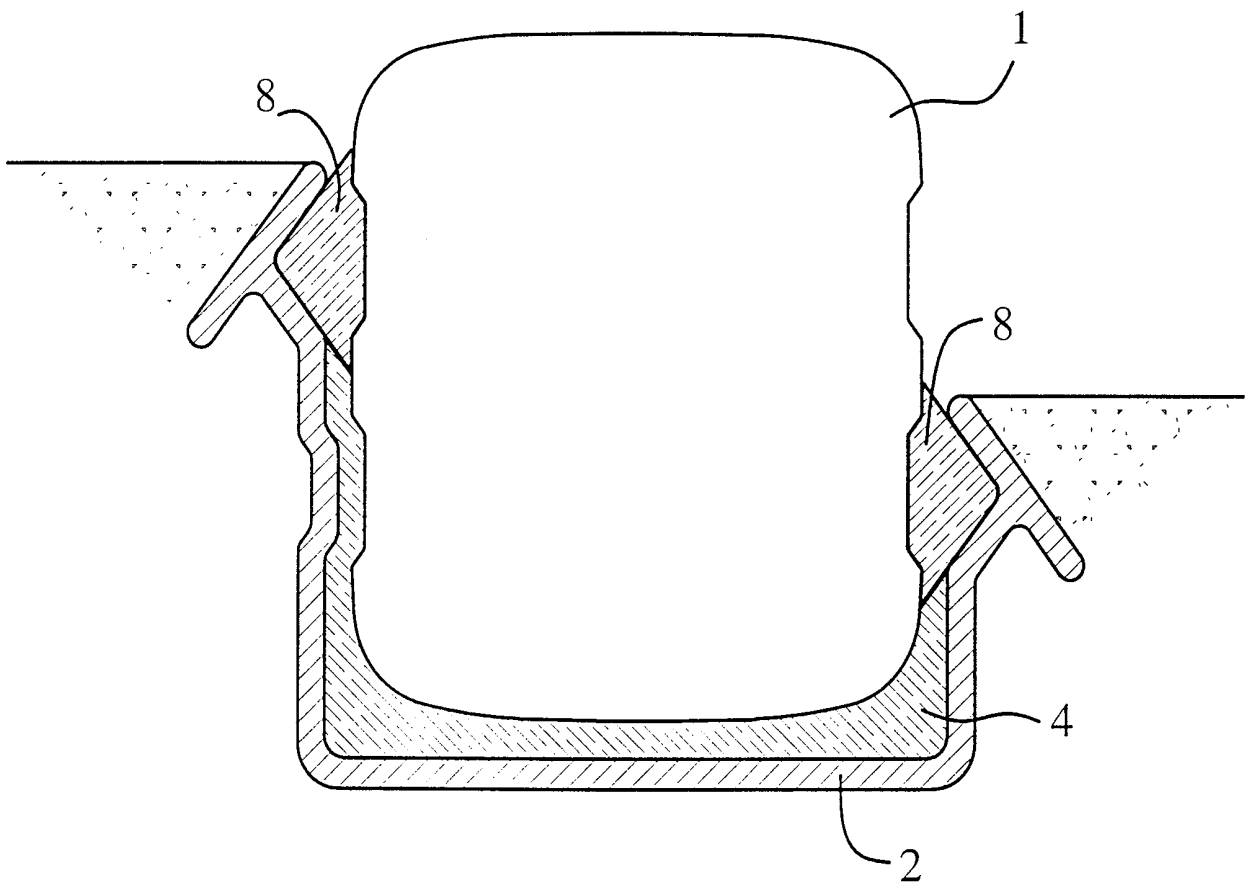


FIG. 8

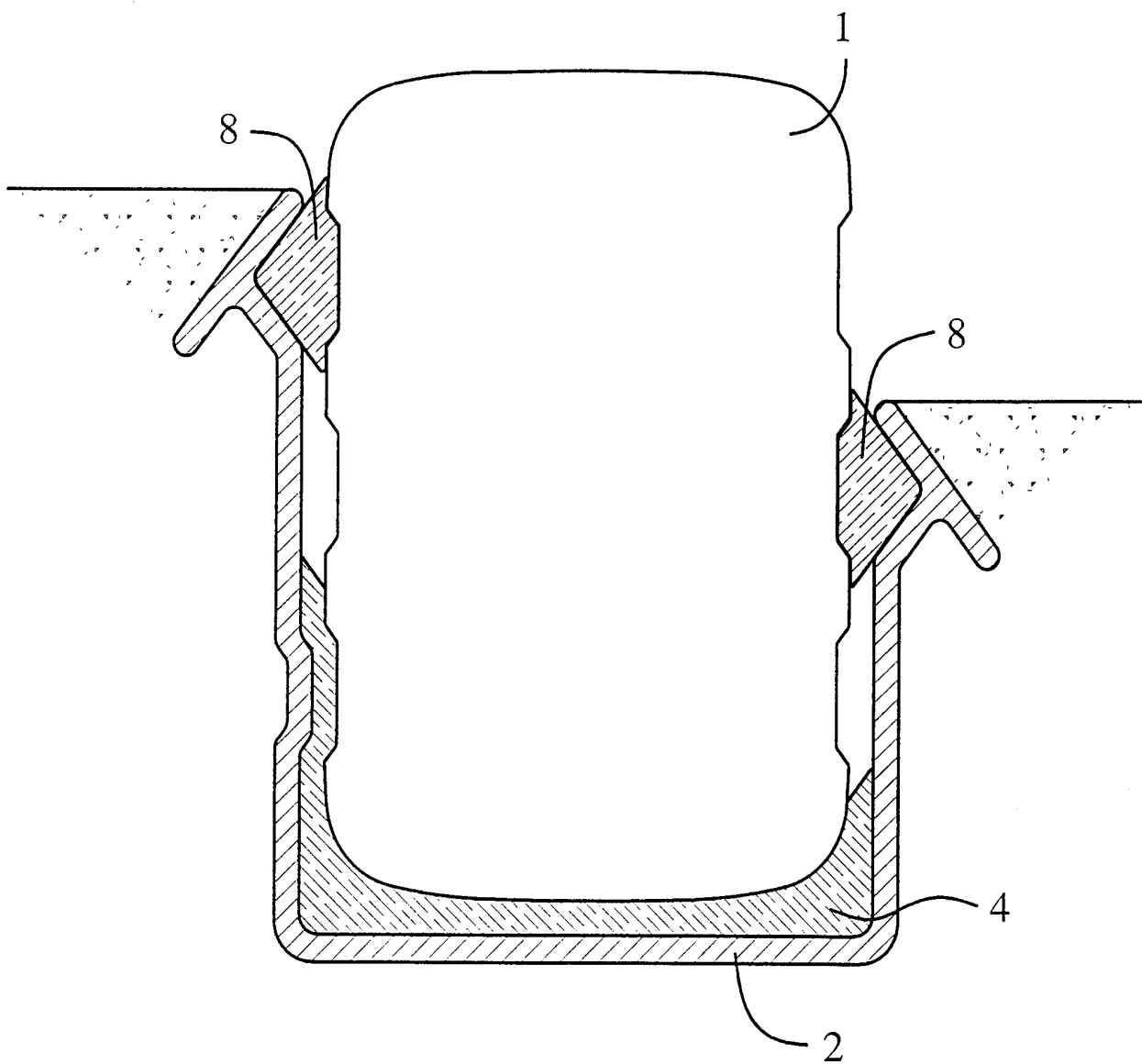


FIG. 9

INTERNATIONAL SEARCH REPORT

International Application No

PC 1, GB 99/01705

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 6 E01B9/60 E01B9/62

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 6 E01B

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	GB 2 272 011 A (PENNY CHARLES) 4 May 1994 (1994-05-04) the whole document	1,4,5, 7-9,11 2,6,10, 12
X A	US 4 775 103 A (ORTWEIN HERMANN) 4 October 1988 (1988-10-04) the whole document	1,3,4, 8-10, 13-15 2,5-7,12
A	DE 196 04 887 A (METZER HORST) 14 August 1997 (1997-08-14) abstract; figures	1-5,8-15
A	DE 44 27 237 A (ORTWEIN HERMANN) 8 February 1996 (1996-02-08) abstract; figures	1-15
	--- -/--	

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

☒ Patent family members are listed in 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 document 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

6 September 1999

Date of mailing of the international search report

15/09/1999

Name and mailing address of the ISA

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

Authorized officer

Blommaert, S

INTERNATIONAL SEARCH REPORT

International Application No

PC 1 / GB 99/01705

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 41 14 803 A (ORTWEIN HERMANN) 12 November 1992 (1992-11-12) abstract; figures -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/01705

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 2272011	A	04-05-1994	NONE	
US 4775103	A	04-10-1988	DE 3540128 A AT 51654 T EP 0222277 A	14-05-1987 15-04-1990 20-05-1987
DE 19604887	A	14-08-1997	NONE	
DE 4427237	A	08-02-1996	AT 171494 T AU 3164595 A CA 2194794 A DE 59503729 D WO 9604425 A EP 0787233 A JP 10503566 T US 5788153 A	15-10-1998 04-03-1996 15-02-1996 29-10-1998 15-02-1996 06-08-1997 31-03-1998 04-08-1998
DE 4114803	A	12-11-1992	NONE	