



- (51) International Patent Classification:
A01G 9/16 (2006.01) *A01G 9/14* (2006.01)
- (21) International Application Number:
PCT/IB2016/054079
- (22) International Filing Date:
7 July 2016 (07.07.2016)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
2015/04890 8 July 2015 (08.07.2015) ZA
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- (81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *of inventorship (Rule 4.17(iv))*

[Continued on next page]

(54) Title: A GREENHOUSE

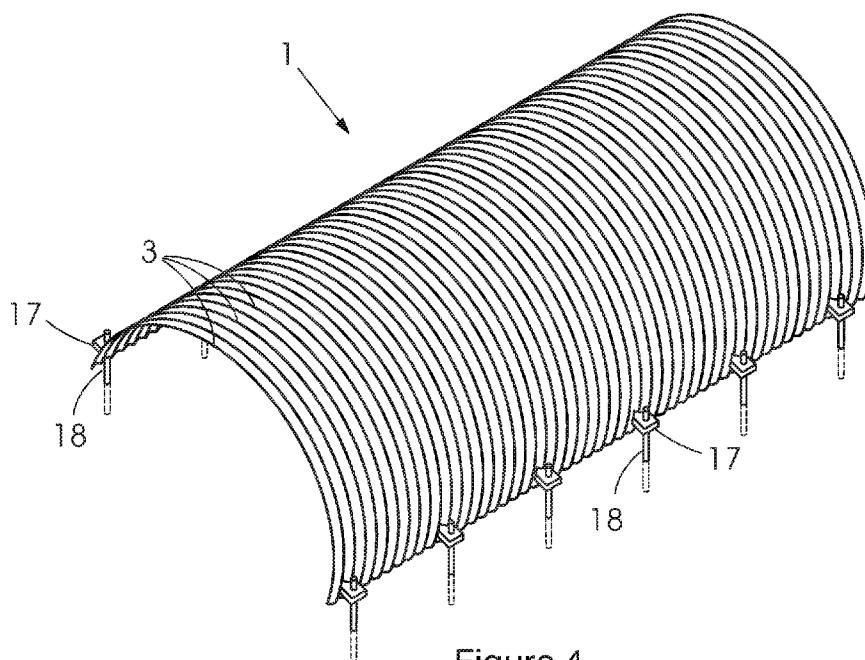


Figure 4

(57) Abstract: A greenhouse that comprises a plurality of arch-shaped elements that are made from a translucent material. The arch-shaped elements are secured side-to-side to provide a self-supporting, tunnel-like structure.





Published:

— *with international search report (Art. 21(3))*

A GREENHOUSE

CROSS-REFERENCE(S) TO RELATED APPLICATIONS

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This application claims priority from South African provisional patent application number 2015/04890 filed on 8 July 2015, which is incorporated by reference herein.

10 FIELD OF THE INVENTION

This invention relates to a greenhouse, more particularly to a tunnel shaped greenhouse.

15 BACKGROUND TO THE INVENTION

Greenhouses have traditionally been constructed using glass panels secured in a frame. These have been replaced in commercial practice by what is often referred to as “grow tunnels”. Grow tunnels are elongate, typically semi-circular tunnels formed by spaced apart, arch-shaped frame elements and which are covered by a sheet of plastics material. Although fairly effective, these structures do suffer the disadvantage that the covering material is subject to wear and degradation. The covering material must thus generally be replaced every few years. Also, the structures can be easily damaged by hail and strong winds and can be fairly expensive to construct and maintain.

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In this specification “translucent” shall have its widest meaning and include “transparent”. Also, “greenhouse” as used in this specification shall be interpreted to include temporary shelters or storage facilities for any material requiring regulated climatic conditions such plants, plant material and the like.

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The preceding discussion of the background to the invention is intended only to facilitate an understanding of the present invention. It should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was part of the common general knowledge in the art as at the priority date of the application.

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SUMMARY OF THE INVENTION

In accordance with this invention there is provided a greenhouse comprising a plurality of arch-shaped elements made from a translucent material and secured side-to-side to provide a self-supporting, tunnel-like structure.

Further features of the invention provide for each arch-shaped element to have interlocking formations on either side thereof, each of which can interlock with a complementary interlocking formation of an adjacent arch-shaped element; for at least some of the arch-shaped elements to be made from a plastics material and for the plastics material to be selected from one or more of polyethylene, polycarbonate material and poly(methyl methacrylate) acrylic glass.

One embodiment of the invention provides for each arch-shaped element to be formed by an inclined surface which provides a radially inner end and a radially outer end with a first side inclined radially outwardly from the inner end and a second side inclined radially inwardly from the outer end to form a first channel section which opens radially outwardly and a second channel section which opens radially inwardly, each channel section providing an interlocking formation.

Further features of this embodiment of the invention provide for the first channel section and second channel section to be U-shaped; alternately for the first channel section and the second channel section to be V-shaped.

Another embodiment of this invention provides for each arch-shaped element to be V-shaped in cross-section provided by a pair of sides inclined from a vertex to form a channel section, alternate arch-shaped elements having sides inclined from the vertex in a radially outwardly direction and a radially inward direction to form a V-shaped channel section facing alternately radially outwardly, and radially inwardly, each channel section thereby providing an interlocking formation.

A still further embodiment of this invention provides for each arch-shaped element to have a part-circular cross-section with a slot extending along a length of its circumference, alternative arch-shaped elements having the slot extending along their outermost circumference and their innermost circumference respectively to so provide interlocking formations.

An even further embodiment of this invention provides for each arch-shaped element to have an inwardly opening channel section with a first side terminating in a radially outwardly lipped, axially directed flange

A still further embodiment of this invention provides for each arch-shaped element to have a tongue that extends in an axial direction along a first edge of the arch-shaped element, and a complementary groove that extends along an opposite second edge of the arch-shaped element, the tongue and groove thus providing interlocking formations.

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Even further features of this invention provide for one or more of the arch-shaped elements to have an anchoring formation for anchoring the structure to a surface or substrate; for a first open end of the structure to include a first attachment formation for attaching a first end wall, and for a second open end of the self-supporting, tunnel-like structure to include a second attachment formation for attaching a second end wall; and for the self-supporting, tunnel-like structure to be portable.

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BRIEF DESCRIPTION OF THE DRAWINGS

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In the drawings:

Figure 1 is a three dimensional view of one embodiment of a greenhouse;

20 Figure 2 is an end elevation of the greenhouse in Figure 1;

Figure 3 is an end elevation of an embodiment of a greenhouse having anchoring formations;

25 Figure 4 is a three dimensional view of the greenhouse of Figure 3;

Figures 5A and 5B are sectional elevations of part of arch-shaped elements used in the construction of the greenhouse in Figure 1;

30 Figure 6A and 6B are sectional elevations of part of arch-shaped elements used in the construction of a second embodiment of a greenhouse;

Figure 7 is a sectional elevation of part of arch-shaped elements used in the construction of a third embodiment of a greenhouse;

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Figure 8 is a sectional elevation of part of arch-shaped elements used in the construction of a fourth embodiment of a greenhouse; and

Figure 9 is a sectional elevation of part of arch-shaped elements used in the construction of a fifth embodiment of a greenhouse;

Figure 10 is a sectional elevation of part of arch-shaped elements used in the construction of a sixth embodiment of a greenhouse;

Figure 11 is a three dimensional view of a greenhouse having an end wall attached to an end thereof.

DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS

A greenhouse (1) is shown in Figures 1 and 2 and is of the tunnel type being elongate with an arched, semi-circular shape in end view. The greenhouse (1) is constructed from a plurality of arch-shaped elements (3) arranged side-to-side to provide a self-supporting structure. Each element (3) is typically elongate and is made from a translucent, plastics material. The elongate elements are configured to provide interlocking formations such that each element can interlock with corresponding interlocking formations of adjacent elements.

In Figure 5A an arch-shaped element having frusto-conical dimensions is shown. As shown, in this embodiment, each arch-shaped element (4) has a generally S-shaped profile in diametrical cross-section. An inclined surface (9) provides a radially inner end (10) and a radially outer end (12). A first side (11) inclined radially outwardly from the inner end (10) and a second side (13) inclined radially inwardly from the outer end (12) form a first channel section (5) which opens radially outwardly and a second channel section (7) which opens radially inwardly. The first channel section (5) and the second channel section (7) thus share the inclined surface (9) to provide the generally S-shaped profile in cross-section, each channel section providing an interlocking formation. Referring also to Figure 5B, a first arch-shaped element and a second arch-shaped element are interlocked side-to-side with each other by locating the radially inwardly inclined side (13) of the first arch-shaped element over the radially outwardly inclined side (11) of the second arch-shaped element. The radially inwardly inclined side (13) of the first arch-shaped element is thus located inside the first channel section (5) of the second arch-shaped element when assembled. The radially inwardly inclined side (13) of the second arch-shaped element is then located over a radially outwardly inclined side (11) of a third arch-shaped element, locating in the first channel section (5) of the third arch-shaped element. The third arch-shaped element (3) is then interlocked side-to-side with the fourth arch-shaped element (3) in a similar way, and each subsequent arch-shaped element is similarly interlocked to an arch-shaped element following it in order to provide a self-supporting greenhouse.

The arch-shaped elements are made from one or more of carefully selected suitable translucent, plastics material such as polyethylene, polycarbonate material and poly(methyl methacrylate) acrylic glass. The arch-shaped elements can also be made from suitable waste plastics material.

5 The plastics material is preferably also treated to be resilient to the effects of ultraviolet radiation and weather conditions. It is anticipated that only some of the arch-shaped element are made from the translucent material and that it can be combined with arch-shaped elements made from more cost effective material should the need arise.

10 When assembled, the interlocked translucent plastics elements provide a structure that is self-supporting and sufficiently resilient to axial and lateral or radial movement. The size of the greenhouse can range from small laboratory-scale sized greenhouses to big commercial-sized greenhouses. The number of arch-shaped elements needed to construct the greenhouse, as well as their preferred dimensions, will be determined based on the preferred size of greenhouse. The
15 greenhouse may, for instance, be used for laboratory-based research in which case the assembled tunnel-like greenhouse may be approximately 30cm in length and approximately 20cm in height. The individual translucent plastics arch-shaped elements will thus be dimensioned to provide such a tunnel-like structure when assembled. For a commercial-sized greenhouse, each arch-shaped element may, for instance, have a length of between 20m and 60m measured from
20 one end to the other and along the arch-shaped length thereof, a thickness of between 10cm and 20cm, and a width of between 1m and 2m. It should, however, be appreciated that these dimensions are for explanatory purposes and a person skilled in the art will appreciate that arch-like elements of any suitable size may be used to assemble the greenhouse.

25 The arch-shaped elements can easily be produced in suitable moulds having the preferred dimensions. Depending on the size of the greenhouse to be assembled, the arch-shaped elements can be interconnected one by one by simply arranging the arch-shaped elements side-by-side in the upright condition. The first arch-shaped element is interconnected to a second arch-shaped element, which is interconnected to a third arch-shaped element, which is interconnected
30 to a fourth arch-shaped element and so forth. It is apparent that any number of subsequent arch-shaped elements can be interconnected to each other, depending on the size of the greenhouse to be constructed.

The plastic arch-shaped elements are light and easy to manoeuvre and assemble. When erecting
35 smaller greenhouses, there is thus no need to use machinery to arrange and interlock the arch-shaped elements side-to-side. The arch-shaped elements can simply be arranged and interconnected by hand by engaging them side-to-side. Even when constructing a larger greenhouse, the need for heavy machinery will be limited as the arch-shaped elements are

lightweight. A greenhouse of this invention is thus simple to construct. It is also easy to extend or shorten the greenhouse by adding or removing arch-shaped elements. Other advantages are that a greenhouse of this invention is inexpensive to erect and also easy to disassemble after use, thus providing a portable greenhouse.

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An even further advantage of the interlocking configuration of the arch-shaped elements (4) is that the U-shaped channel section (5) of each element (4) forms a gutter into which precipitation is channelled, thereby limiting the effect of precipitation on the greenhouse. The gutters may be interconnected when the greenhouse is erected, to provide an interconnected gutter system at or
10 near a bottom portion of the greenhouse to feed and direct precipitation to a reservoir, which may in turn be used as a source for an irrigation system to be implemented in the greenhouse.

The erected greenhouse can be anchored in any suitable manner. As shown in Figure 2, the free ends (15) of the arch-shaped elements (3) can be buried below the surface, such as the ground,
15 to avoid dislodgment or displacement of the greenhouse (1) by strong winds and other forces of nature. The greenhouse will typically be anchored this way if the necessity to move the greenhouse from one location to another is unlikely.

If the user expects to move the greenhouse from time to time, it does not make practical sense
20 to bury the free ends of the arch-shaped elements. Avid gardeners can, for instance, use a greenhouse of this invention in their gardens. To optimise exposure to the sun the greenhouse might thus be moved from one place to another from time to time. As shown in Figures 3 and 4, one or more of the arch-shaped elements can be provided with anchoring formations for easy anchoring to a surface. In this embodiment, the anchoring formations are outwardly extending lug
25 (17) located at or near free ends of the arch-shaped elements. Each lug has an aperture for receiving an anchoring rod (18) there through for anchoring the greenhouse. An anchoring rod (18) is located through the lug (17) and driven into the surface by using a hammer or other heavy object. The anchoring rod (18) can be removed from the surface with relative ease.

30 In a sheltered environment it might not be necessary for the greenhouse to be anchored, making it easy to move the greenhouse from one location to another should the need arise.

A highly effective yet easily constructed greenhouse is thus provided. It will be appreciated, however, that many other embodiments of a greenhouse exist which fall within the scope of the
35 invention, particularly as regards the configuration of the arch-shaped elements.

Figure 6A shows another embodiment of an arch-shaped element having frusto-conical dimensions. In this embodiment, each arch-shaped element (20) has a generally Z-shaped profile

in diametrical cross-section. An inclined surface (25) provides a radially inner end (26) and a radially outer end (29). A first side (27) inclined radially outwardly from the inner end (26) and a second side (28) inclined radially inwardly from the outer end (29) form a first channel section (21) which opens radially outwardly and a second channel section (23) which opens radially inwardly. The first channel section (21) and the second channel section (23) thus share the inclined surface (25) to provide the generally Z-shaped profile in cross-section, each channel section providing an interlocking formation. Referring also to Figure 6B, a first arch-shaped element and a second arch-shaped element are interlocked side-to-side with each other by locating the radially inwardly inclined side (28) of the first arch-shaped element over the radially outwardly inclined side (27) of the second arch-shaped element. The radially inwardly inclined side (28) of the first arch-shaped element is thus located inside the first channel section (21) of the second arch-shaped element when assembled. The radially inwardly inclined side (28) of the second arch-shaped element is then located over a radially outwardly inclined (27) of a third arch-shaped element, locating in the first channel section (21) of the third arch-shaped element. The third arch-shaped element (20) is then interlocked side-to-side with the fourth arch-shaped element (20) in a similar way, and each subsequent arch-shaped element is similarly interlocked to an arch-shaped element following it in order to provide a self-supporting greenhouse.

As shown in Figure 7, each arch-shaped element (30) can have a V-shaped diametrical cross-section. The V-shaped cross-section is provided by a first side (31) and a second side (33) inclined from a vertex (34) to form a channel section (35). Alternate arch-shaped elements (30) have sides inclined from the vertex in a radially outwardly direction and a radially inward direction to form a V-shaped channel section facing alternately radially outwardly and radially inwardly, each channel section thereby providing an interlocking formation. A first arch-shaped element (30) and a second arch-shaped element (30) are interlocked side-to-side with each other by locating the radially outwardly inclined second side (33) of the first arch-shaped element (30) inside a radially inwardly facing channel section (35) of the second arch-shaped element (30). A third arch-shaped element (30) is interlocked with the second arch-shaped element by locating a radially outwardly inclined first side (31) of third arch-shaped element inside the radially inwardly facing channel section (35) of the second arch-shaped element (30). Subsequent arch-shaped elements are interconnected in similar fashion.

In another embodiment, shown in Figure 8, each adjacent arch-shaped element (40) has a diametrical part-circular cross-section. In this embodiment each element (40) is tubular with a slot (42) extending along a length of its circumference. Alternate elements (40) have the slot (42) extending along the outermost circumference (45) and the innermost circumference (47). These could, for example, be obtained by providing a longitudinal slot or slit within a suitable plastics pipe or tube. The elements (40) are arranged with an array of lower elements, each abutting each

other and an alternating array of upper elements which also abut each other. These are interconnected by sliding the slot of an upper element over the abutting sides of a pair of lower elements from one end of the elements. This is repeated for subsequent elements to form a greenhouse of desired length.

5 As shown in Figure 9, each arch-shaped element (50) could have an inwardly opening channel section (51) with a first side terminating in a radially outwardly lipped, axially directed flange (52). In this embodiment the inwardly opening channel section (51) is U-shaped, having a radially inwardly inclined side (54). When interconnecting two adjacent arch-shaped elements (50), the
10 radially inwardly inclined side (54) of the first arch-shaped element (50) is received into a radially outwardly lipped, axially directed flange (52) of a second arch-shaped element. Subsequent arch-shaped elements are interconnected in similar fashion to form a tunnel-like structure.

As shown in Figure 10, each arch-shaped element (60) could have a tongue (61) extending
15 generally axially from a first edge (62) thereof, and a complementary groove (63) formed in the opposite edge (64) thereof. The tongue (61) of a first arch-shaped element defines an interlocking formation for interlocking with a groove (63) on an adjacent element.

Many other interlocking formations will be apparent to those skilled in the art.

20 It will be apparent that the greenhouse could be fitted with end walls, such as solid panels or flexible covers at either end. These may include doors (73). As shown in Figure 11, one or more attachment formations (71) may be located on an external surface of the arch-shaped elements for securing an end wall, such as a door (73) thereto.

25 It will also be apparent that means for heating or forcing air through the greenhouse may be provided. It will further be apparent that the greenhouse provided could be used for temporary shelter or storage and need not only be used for growing plants.

30 Throughout the specification and claims, unless the contents require otherwise, the word 'comprise' or variations such as 'comprises' or 'comprising' will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

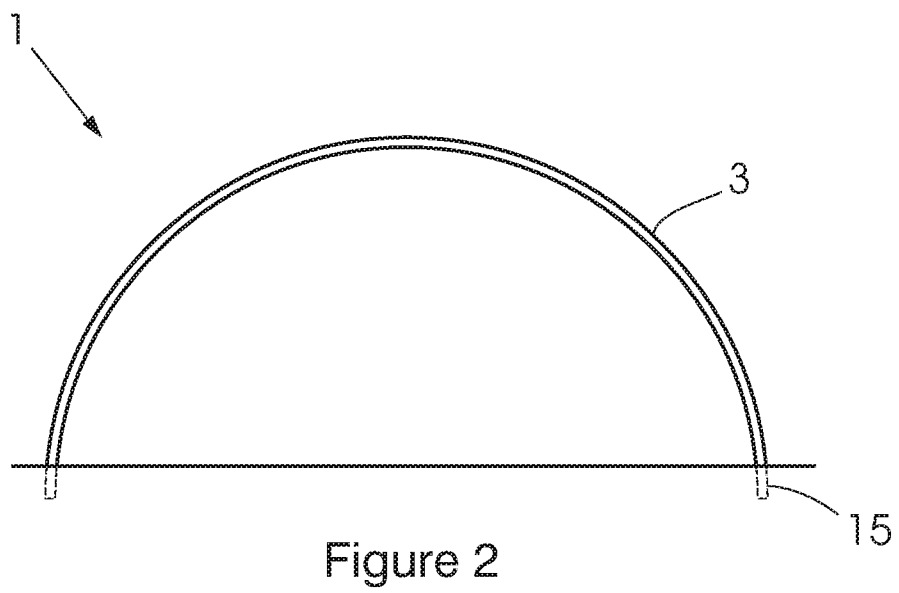
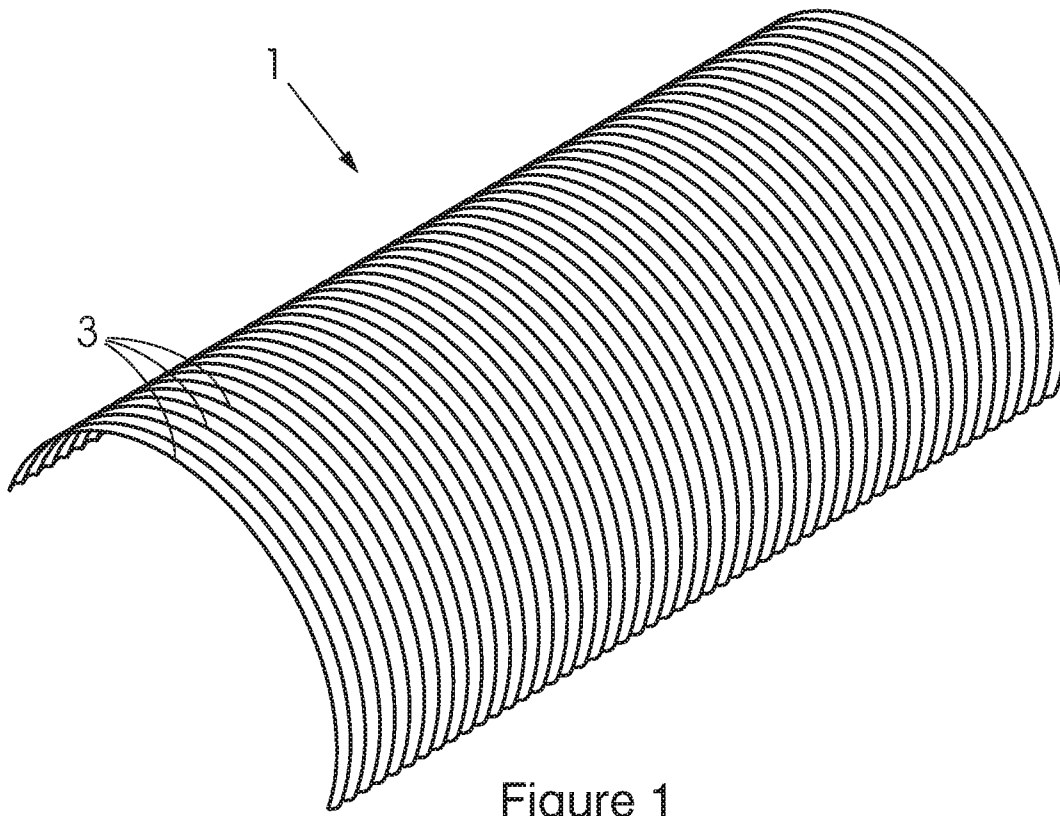
CLAIMS:

1. A greenhouse comprising a plurality of arch-shaped elements made from a translucent material and secured side-to-side to provide a self-supporting, tunnel-like structure.
2. A greenhouse as claimed in claim 1, wherein each arch-shaped element has interlocking formations on either side thereof, each of which can interlock with a complementary interlocking formation of an adjacent arch shaped element.
3. A greenhouse as claimed in any one of claims 1 or 2, wherein at least some of the arch-shaped elements are made from a plastics material.
4. A greenhouse as claimed in claim 3, wherein the plastics material is selected from one or more of polyethylene, polycarbonate material and poly(methyl methacrylate) acrylic glass.
5. A greenhouse as claimed in any one of claims 1 to 4, wherein each arch-shaped element is formed by an inclined surface which provides a radially inner end and a radially outer end with a first side inclined radially outwardly from the inner end and a second side inclined radially inwardly from the outer end to form a first channel section which opens radially outwardly and a second channel section which opens radially inwardly, each channel section providing an interlocking formation.
6. A greenhouse as claimed in claim 5, wherein the first channel section and the second channel section are U-shaped.
7. A greenhouse as claimed in claim 5, wherein the first channel section and the second channel section are V-shaped.
8. A greenhouse as claimed in any one of claims 1 to 4, wherein each arch-shaped element has a V-shaped cross-section provided by a pair of sides inclined from a vertex to form a channel section, alternate arch-shaped elements having sides inclined from the vertex in a radially outwardly direction and a radially inward direction to form a V-shaped channel section facing alternatively radially outwardly, and radially inwardly, each channel section thereby providing an interlocking formation.
9. A greenhouse as claimed in any one of claims 1 to 4, wherein each arch-shaped element has a part-circular cross-section with a slot extending along a length of its circumference, alternate arch-shaped elements having the slot extending along their

outermost circumference and their innermost circumference respectively to so provide interlocking formations.

- 5 10. A greenhouse as claimed in any one of claims 1 to 4, wherein each arch-shaped element has an inwardly opening channel section with a first side terminating in a radially outwardly lipped, axially directed flange.
- 10 11. A greenhouse as claimed in any one of claims 1 to 4, wherein each arch-shaped element has a tongue that extends in an axial direction along a first edge of the arch-shaped element, and a complementary groove that extends along an opposite second edge of the arch-shaped element, the tongue and groove providing interlocking formations.
- 15 12. A greenhouse as claimed in any one of the preceding claims, wherein one or more of the elements have an anchoring formation for anchoring the structure to a surface or substrate.
- 20 13. A greenhouse as claimed in any one of the preceding claims, wherein a first open end of the structure includes one or more first attachment formations for attaching a first end wall, a second open end of the structure including one or more second attachment formations for attaching a second end wall.
- 25 14. A greenhouse as claimed in any one of the preceding claims, wherein the self-supporting, tunnel-like structure is portable.
- 30 15. An arch-shaped element for constructing a greenhouse as claimed in any one of the preceding claims.

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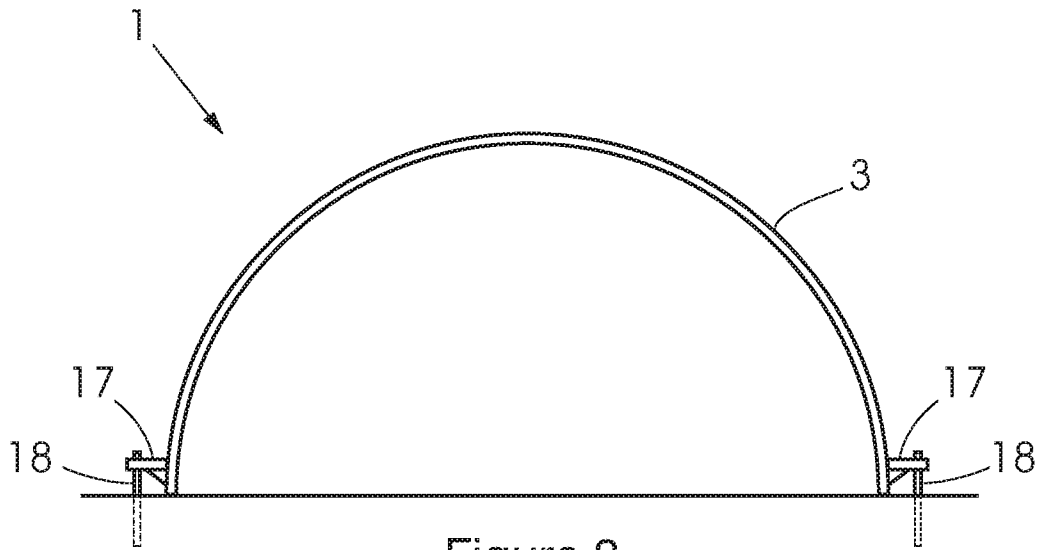


Figure 3

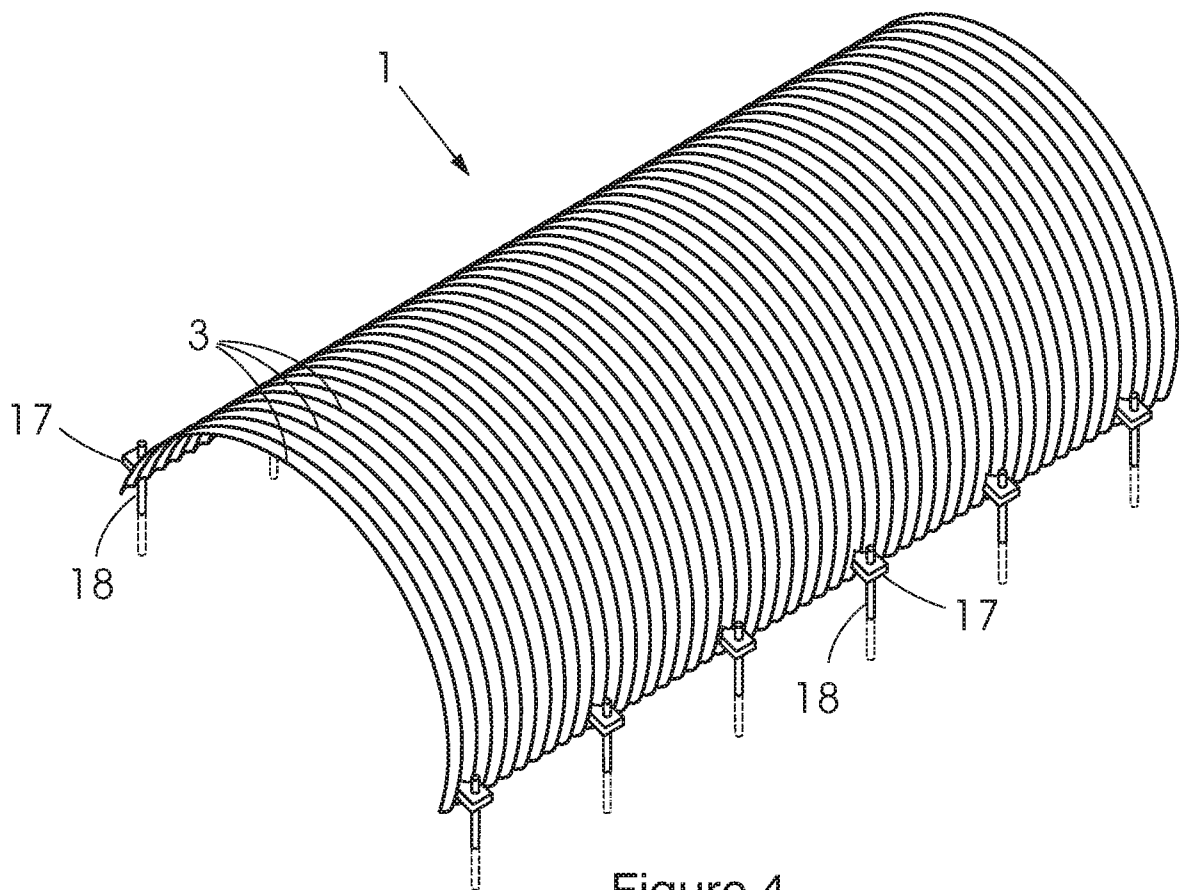


Figure 4

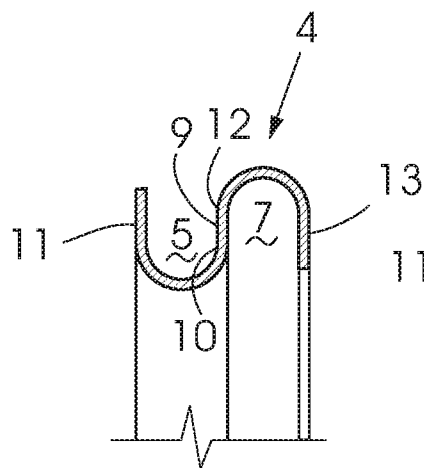


Figure 5A

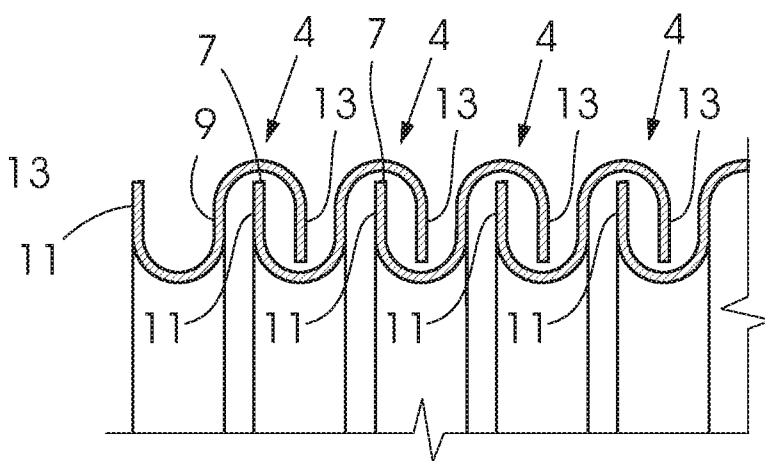


Figure 5B

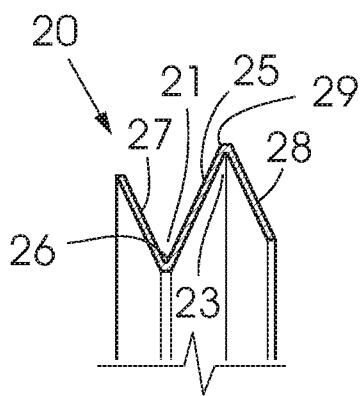


Figure 6A

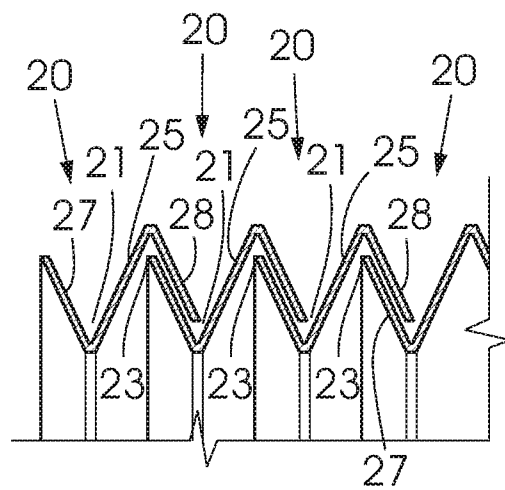


Figure 6B

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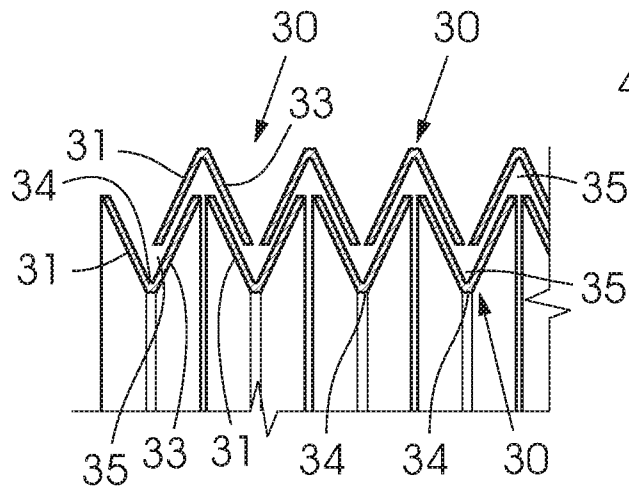


Figure 7

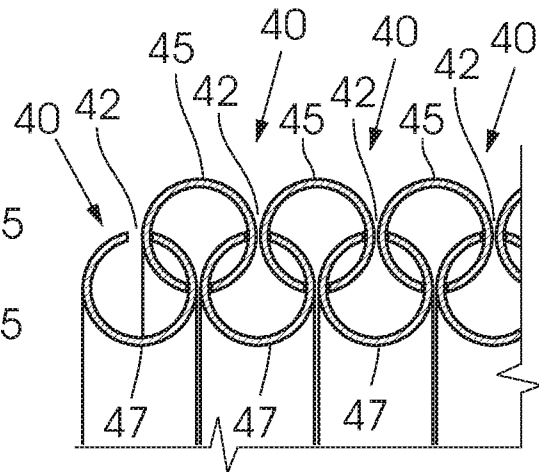


Figure 8

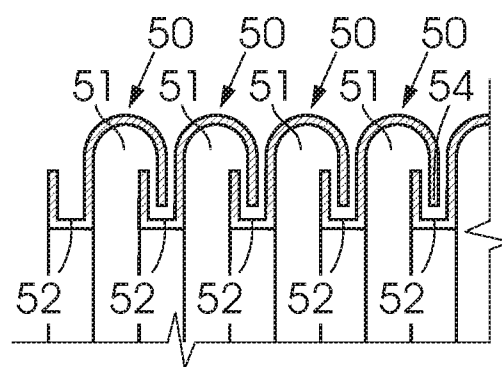
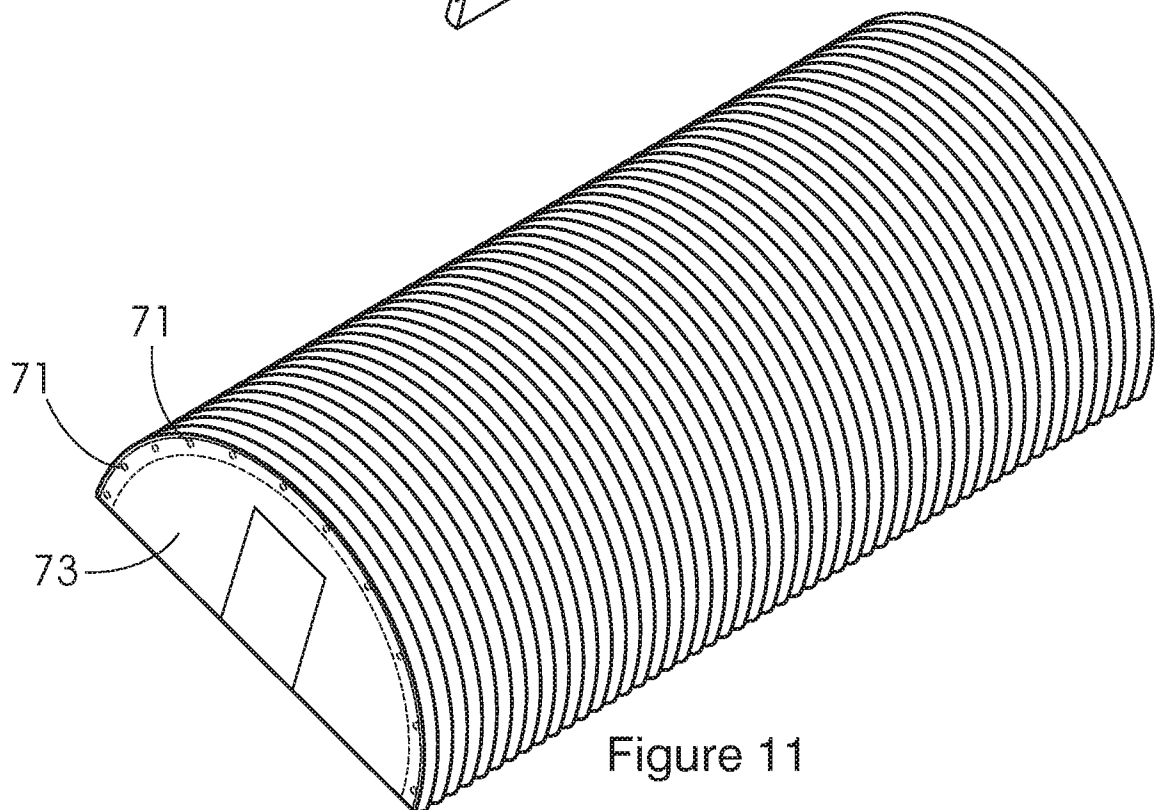
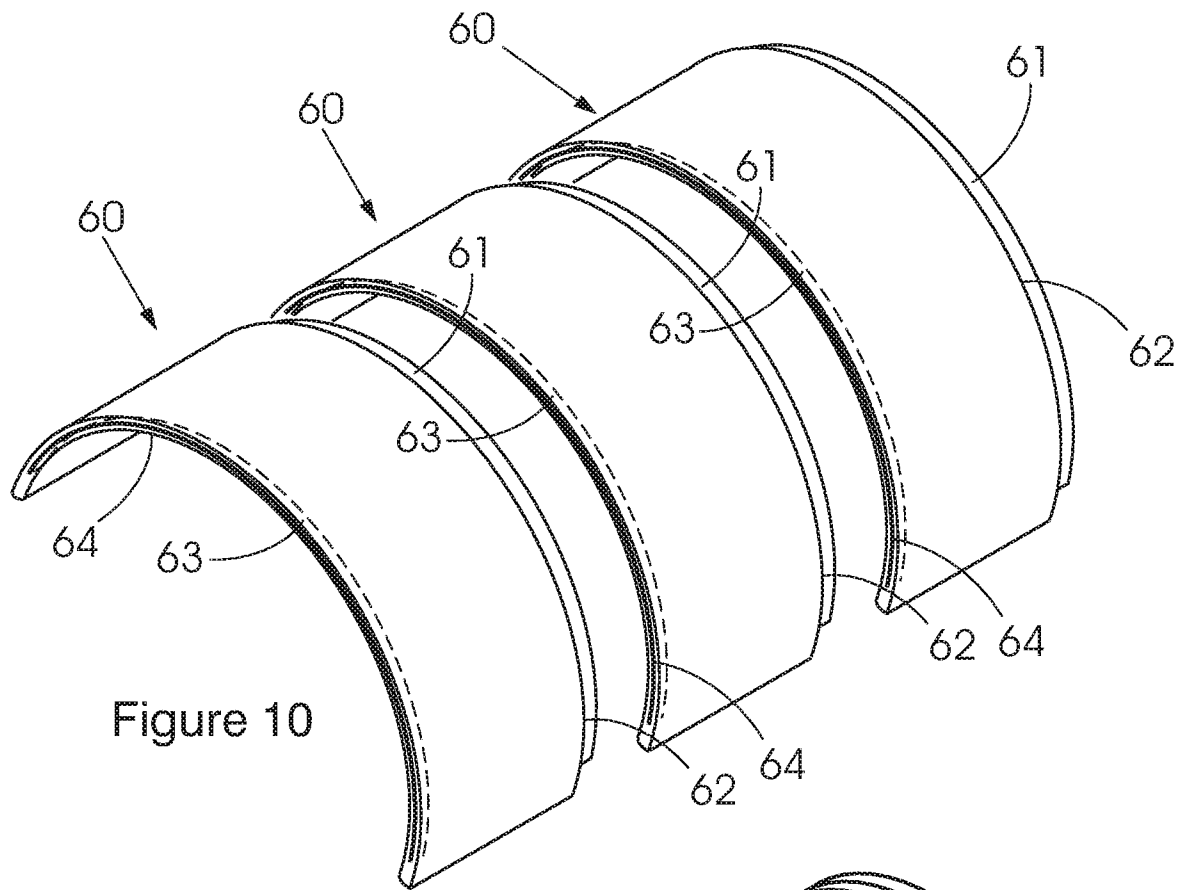


Figure 9

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INTERNATIONAL SEARCH REPORT

International application No.

PCT / IB 2016/054079

A. CLASSIFICATION OF SUBJECT MATTER IPC: A01G 9/16 (2006.01); A01G 9/14 (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) A01G 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		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2006115703 A (KAWANO GIKEN) 11 May 2006 (11.05.2006) whole document	1-15
X	EP 0339216 A1 (POLYU' ITALIANA S.R.L) 02 November 1989 (02.11.1989) whole document	1-15
X	FR 2552467 A1 (UNDER SUN SRL) 29 March 1985 (29.03.1985) whole document	1-15
A	DE 2439027 A1 (SCHOELL, GUENTER, PROF. DR.-ING., LOCARNO-MURALTO (SCHWEIZ)) 26 February 1976 (26.02.1976) whole document	5-8
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 26 August 2016 (26.08.2016)		Date of mailing of the international search report 08 September 2016 (08.09.2016)
Name and mailing address of the ISA/AT Austrian Patent Office Dresdner Straße 87, A-1200 Vienna Facsimile No. +43 / 1 / 534 24-535		Authorized officer HUNGER U. Telephone No. +43 / 1 / 534 24-363

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT / IB 2016/054079

Patent document cited in search report			Patent family member(s)			Publication date
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			EP	A1	0339216	1989-11-02
			ES	T3	2031649	1992-12-16
			MC	A	2030	1990-04-25
			DE	T2	68901744	1992-12-17
FR	A1	2552467	FR	A1	2552467	1985-03-29
DE	A1	2439027	DE	A1	2439027	1976-02-26