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(54) Title: CABLE SEALING ASSEMBLY

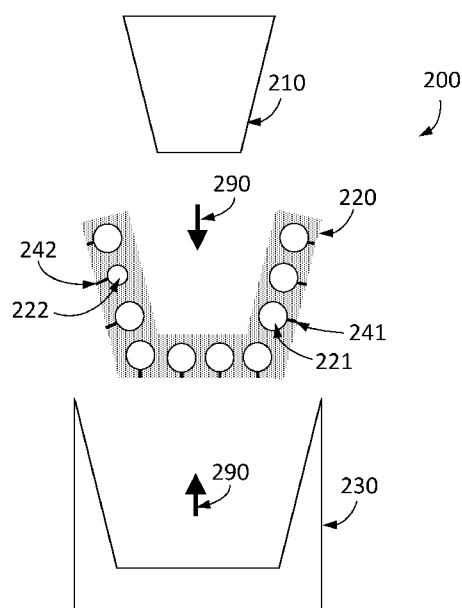


Figure 2

(57) Abstract: A cable sealing assembly (200) for a cable entry (115) in a cabinet (100) housing electronic equipment. The cable sealing assembly (200) comprises a tongue-shaped protruding member (210), an elastic cable sealing member (220) configured to be shaped around the edge of the tongue-shaped protruding member (210) and a corresponding recessed member (230) configured to receive the protruding member (210) and the cable sealing member (220) in between. The elastic cable sealing member (220) has a plurality of through holes (221, 222) forming a single row, each hole (221, 222) configured to have a cable (130) extending there through. The cable sealing assembly (200) is configured to seal the cable entry (115) when the protruding member (210) and the recessed member (230) together apply an even pressure on the cable sealing member (220).

CABLE SEALING ASSEMBLY

TECHNICAL FIELD

The disclosure relates to a cable sealing assembly for a cabinet housing electronic equipment.

5 BACKGROUND

Electronic equipment like base station transceivers, servers and routers are normally mounted in cabinets. In outdoor installations it is important that the cable entry to the cabinet is securely sealed to prevent dust and humidity to enter the cabinet and damage the electronics. A cable entry for outdoor equipment is often
10 designed to receive a plurality of cables. These can be of different sorts and sizes (copper, fibre), or having different purposes (power, transmission, signalling etc).

US patent 8,541,698 discloses an example of a cable distribution cabinet having a cable entry underneath the cabinet comprising a base plate for receiving and sealing a plurality of cables entering the cabinet. Within the base plate a plurality of elastic sealing blocks is
15 threaded on guide rods resulting in two straight lines of holes for receiving cables. The cabinet in US 8,541,698 is further configured with front doors allowing access to the cables and the electronics.
20

In compact installations where the cable entry is concentrated to a relatively small area underneath the cabinet, the cables need to be stacked in multiple rows or in bundles. This makes it difficult to access all cables during maintenance or upgrades of the cable configuration. Connecting or disconnecting the innermost
25 cables in the stack for example, will be very difficult without interfering with or disconnecting other cables in front of the innermost cables.
30

Another problem is that with cable sealings having a plurality of through holes configured to receive a bundle of cables, it is difficult to apply an even pressure on the sealing for each individual cable.

5 SUMMARY

With this background it is the object of the embodiments described below to obviate at least one of these disadvantages.

The object is achieved by a cable sealing assembly having
10 a tongue-shaped protruding member, an elastic cable sealing member and a corresponding recessed member configured to receive the protruding member and the cable sealing member in between. The elastic cable sealing member has a plurality of through holes forming a single
15 row, each hole configured to have a cable extending there through and wherein the cable sealing member is configured to be shaped around the edge of the tongue-shaped protruding member. The cable sealing assembly is further configured to seal the cable entry when the
20 protruding member and the recessed member together apply an even pressure on the cable sealing member. In one embodiment, the even pressure is achieved when the cabinet's detachable cover engages with the cable sealing assembly so that the protruding member and the recessed
25 member applies the even pressure on the cable sealing member when the cover is mounted to the cabinet.

An advantage with the tongue-shaped assembly is that as the cables are mounted in a single row around the protruding member each individual cable can easily be
30 accessed, inserted in or removed from the seal and plugged into or removed from the socket of the electronics without interfering with other cables. Another advantage is that when an even pressure is applied on the elastic cable sealing member it ensures

that an even pressure is applied on each cable so that the cable entry becomes water and dust proof.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1a-1c are block diagrams illustrating a cabinet
5 having a cable entry and a cable sealing assembly according to any of the described embodiments.

Figure 2 is a block diagram illustrating a first embodiment of a cable sealing assembly and its members.

Figure 3 is a block diagram illustrating a second
10 embodiment of a cable sealing assembly and its members.

Figure 4 is a block diagram illustrating a third embodiment of a cable sealing assembly and its members.

Figure 5 is a more detailed block diagram illustrating an
15 embodiment of a cable sealing assembly when mounted in a cabinet.

DETAILED DESCRIPTION

Figures 1a-1c illustrate an outdoor installation of a cabinet 100 having a cable sealing assembly 200 as in any of the described embodiments. Figure 1a is a cross-section of a side view, Figure 1b is a cross-section of a front view and Figure 1c is a cross-section of a top and/or bottom view of said cabinet 100.

Figure 1c also illustrates a compact installation comprising a plurality 100,101,102 of such cabinets 100. The cabinets 100,101,102 are all mounted side by side on a rail 190 which for example can be located on a wall. One short side of the cabinet 100 faces the rail 190, the other short side is the front 140.

The cabinet 100 comprises a metal enclosure 110 configured to house electronic and/or photonic equipment (such as digital baseband units, radio transceivers etc) comprising one or several printed circuit boards (PCBs) 150. The PCB(s) 150 comprise sockets 151 for plugging the cables 130 entering the cabinet 100 to the electronics. Each socket 151 faces the front 140 of the cabinet 100 and the cables 130 enter the cabinet 100 through a cable entry 115 underneath and at the front 140. The cables 130 can be of different sorts (copper and/or fibre) and diameters. For maintenance or upgrades of the cable configuration, the front 140 is provided with a metal detachable cover 120. To meet outdoor installation requirements, the cable entry 115 is further provided with a cable sealing assembly 200.

Figure 2 illustrates a first embodiment of a cable sealing assembly 200 comprising a tongue-shaped protruding member 210, an elastic cable sealing member 220 and a corresponding recessed member 230 configured to receive the protruding member 210 and the cable sealing member 220 in between. The cable sealing member 220 is

made of a silicon based material or a thermo plastic material preferably within the flexibility range of A30-A50 on the Shore hardness scale. The sealing member 220 has further a plurality of through holes 221,222 (that
5 could have different diameters) that forms a single row, each hole configured to have a cable 130 extending there through. Each hole 221,222 is further configured with a slit 241,242 extending from the hole 221,222 to the exterior of the sealing member 220 and facing the
10 recessed member 230 as to permit the insertion of a cable 130 when pulled apart. In this embodiment, the cable sealing member 220 is moulded in one piece having a V- or U-shape and configured to be shaped around the edge of the tongue-shaped protruding member 210. To seal the
15 cable entry 115 when the cables 130 are mounted, the protruding member 210 and the recessed member 230 are configured to together apply an even pressure 290 on the cable sealing member 220.

In a second embodiment as illustrated by Figure 3, the
20 cable sealing member 220 comprises a plurality of sealing elements 311-315 which put together forms the sealing member 220. Each element 311-315 is configured with at least one hole 3141 with a slit 3142 facing the recessed member 230. Again, to seal the cable entry 115, the
25 protruding member 210 and the recessed member 230 are configured to together apply an even pressure 290 on the sealing elements 311-315.

In a third embodiment illustrated by Figure 4, the cable
30 sealing member 220 comprises a first 421 and a second 422 v- or u-shaped sealing element each sealing element 421,422 moulded in one piece and having a plurality of semi-circular cavities 425 in a row. When the two sealing elements 421,422 are put together with the cavities 425 face to face, they form the sealing member 220 with

through holes 430, each hole 430 configured to have a cable 130 extending there through.

In the third embodiment both sealing elements 421, 422 can be loose elements but preferably the first sealing
5 element 421 is attached to the protruding member 210 and the second sealing element 422 is attached to the recessed member 230.

Figures 1a-1c and Figure 5 illustrate the cable sealing assembly 200 when mounted in the cable entry 115 of the
10 cabinet 100. Figure 5 shows a closer view illustrating that when the detachable cover 120 is mounted to the enclosure 110, it engages with the cable sealing assembly 200 so that an even pressure 290 is applied on the sealing member 220.

15 For the different embodiments of the cable sealing assembly 200 it is preferred that the protruding member 210 and the recessed member 230 are of metal and fixed to or being an integral part of the enclosure 110 and the detachable cover 120 respectively.

20 The cable sealing member 220 on the other hand is preferred to be easily replaceable. The sealing member 220 could optionally be kept in place on the protruding member 210 or the recessed member 230 by gluing or some other fastening means as long as it is easy to remove and
25 attach.

Optionally, the cable sealing member 220 is at least partly covered with a conductive layer configured to provide a low impedance path between the protruding member 210 and the recessed member 230 when the cable
30 entry 115 is sealed. The purpose of the conductive layer is to improve the electrical shielding performance, to be able to comply to relevant Electromagnetic Compatibility (EMC) requirements. When the cabinet 100 is mounted in

close vicinity of radio frequency (RF) equipment, the conductive layer is also used to improve the PIM (Passive Intermodulation) performance.

5 As the cables 130 are mounted in a single row in the tongue-shaped cable sealing assembly 200, each individual cable 130 can easily be accessed and each cable can be inserted in or removed from the seal and plugged into or removed from the socket 151 on the PCB 150 without interfering with other cables.

10 The installation procedure when using the first or the second embodiment of the cable sealing assembly 200, is to remove the detachable cover 120 exposing the cable sealing assembly 200. The cables 130 are inserted in its respective slit 241,242,3141,3142 in the sealing element
15 220. Different type of cables could have different outer diameters, hence need to be placed in a certain position. Already at this stage, the cables are held in place by the sealing element 220 itself. When the detachable cover 120 is mounted to the enclosure 110 it engages with the
20 cable sealing assembly 200 so that the protruding member 210 and the recessed member 230 together apply an even pressure 290 on the cable sealing member 220 resulting in that each slit 241,242,3141,3142 closes and the cable sealing assembly 200 becomes water and dust tight. When
25 the cable configuration need to be changed, the detachable cover 120 is removed again and all cables 130 are easily accessible.

When using the described cable assembly 200 in the cable entry 115 it has been tested and verified to comply with
30 at least the rating IP65 according to the Ingress Protection standard IEC 60529.

CLAIMS

1. A cable sealing assembly (200) for a cable entry (115) in a cabinet (100) said cabinet (100) configured to house electronic equipment and comprising an enclosure (110) and a detachable cover (120), the cable sealing assembly (200) *characterised by;*

- a tongue-shaped protruding member (210);

- an elastic cable sealing member (220) having a plurality of through holes (221,222) forming a single row, each hole configured to have a cable (130) extending there through and wherein said cable sealing member (220) is configured to be shaped around the edge of said tongue-shaped protruding member (210);

- a corresponding recessed member (230) configured to receive the protruding member (210) and the cable sealing member (220) in between;

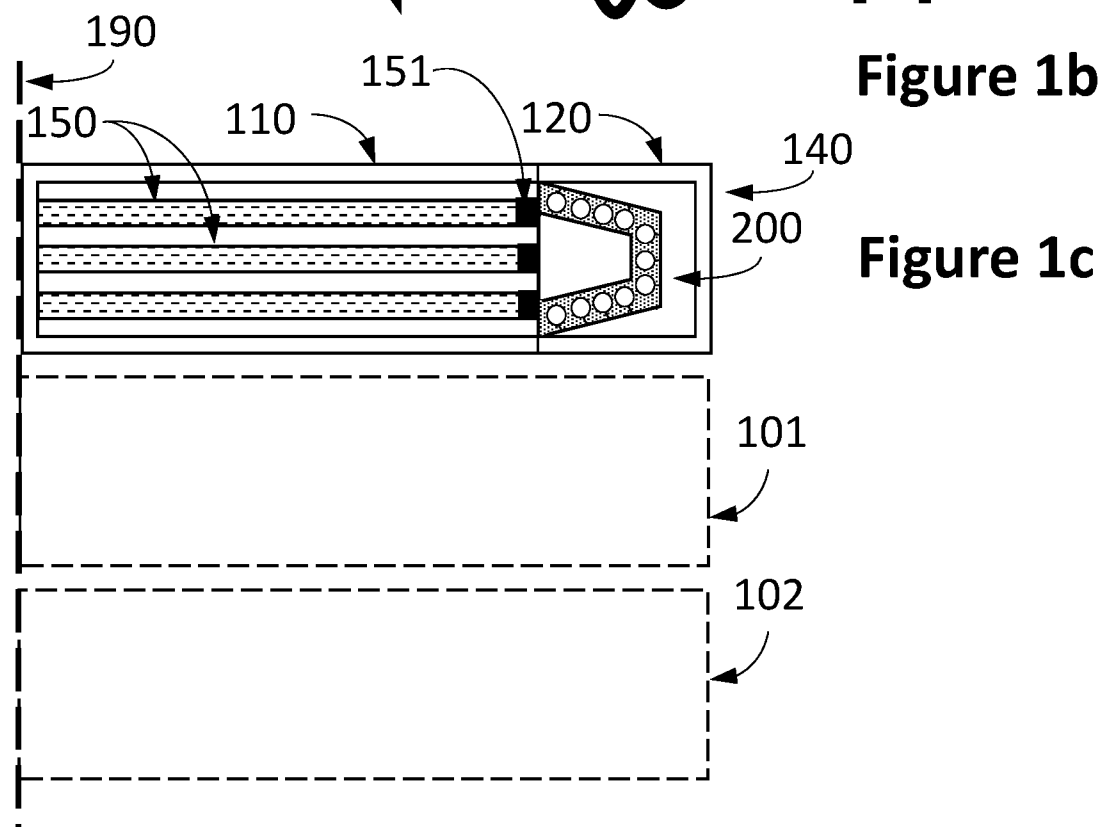
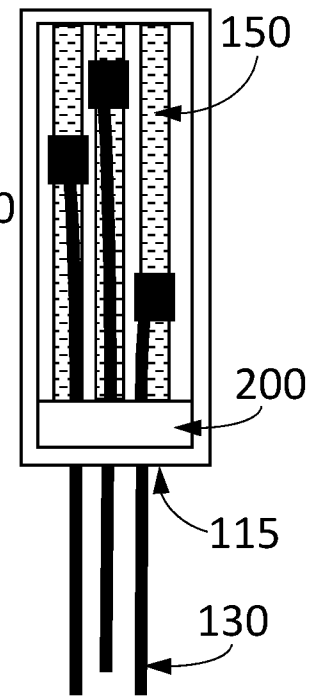
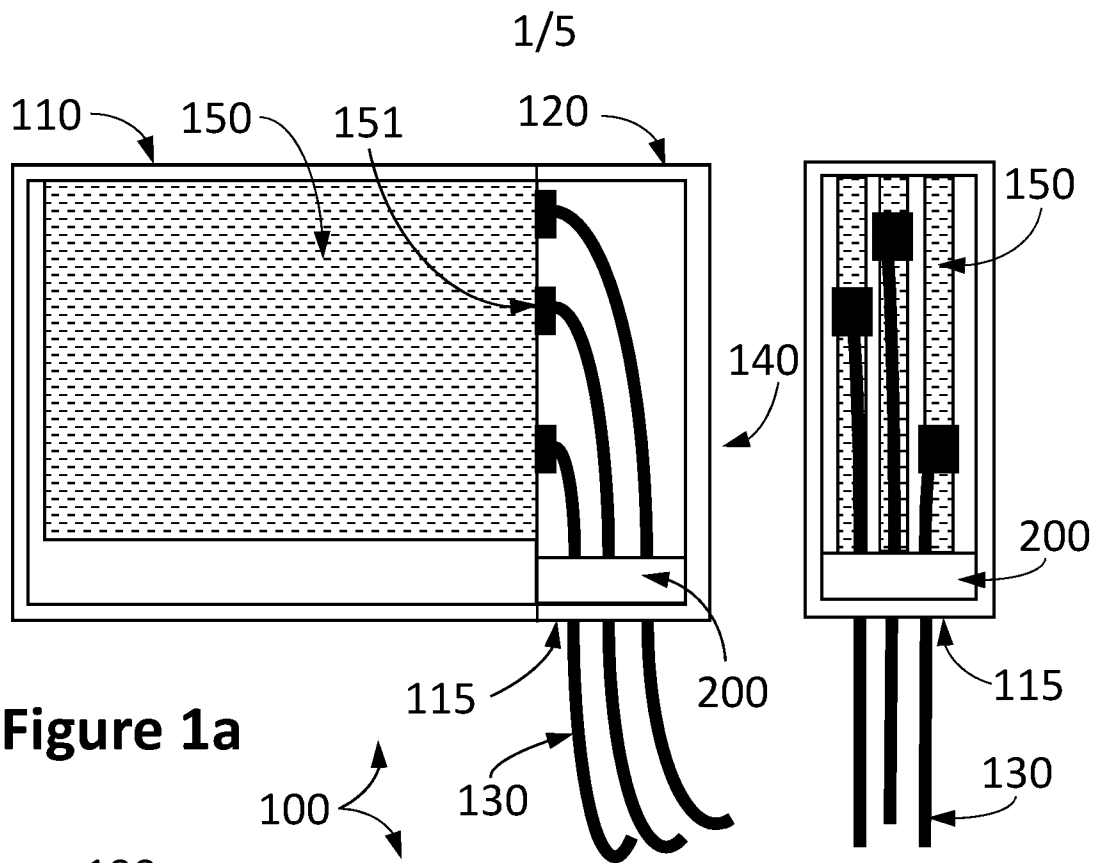
and wherein the cable sealing assembly (200) is further configured as to seal the cable entry (115) when the protruding member (210) and the recessed member (230) together apply an even pressure (290) on the cable sealing member (220).

2. A cable sealing assembly (200) as in claim 1 wherein each hole (221,222) in the cable sealing member (220) is configured with a slit (241,242) extending from the hole (221,222) to the exterior of the sealing member (220) as to permit insertion of a cable (130) when pulled apart and wherein each slit (241,242) is facing the recessed member (230).

3. A cable sealing assembly as in claim 1 or 2 wherein the cable sealing member (220) is a single preformed sealing element.
4. A cable sealing assembly as in claim 1 or 2 wherein the
5 cable sealing member (220) comprises a plurality of preformed separate sealing elements (311-315) located side-by-side, each sealing element (311-315) comprising at least one hole (3141) with a slit (3142).
5. A cable sealing assembly (200) as in claim 1
10 wherein the cable sealing member (220) comprises a first and a second separate sealing element (421,422) each sealing element having a plurality of semi-circular cavities (425) in a row and configured as to, when the two sealing elements
15 (421,422) are put together with the cavities (425) face to face, form a single sealing element (220) with through holes in a row each hole configured to have a cable (130) extending there through.
6. A cable sealing assembly (200) as in claim 5
20 wherein the first sealing element (421) is attached to the protruding member (210) and the second sealing element (422) is attached to the recessed member (230).
7. A cable sealing assembly (200) as in any of the
25 preceding claims wherein at least two of the holes (221,222) in the cable sealing member (220) have different diameters.
8. A cable sealing assembly (200) as in any of the
30 preceding claims wherein the cable sealing member (220) is made of a silicon based material.
9. A cable sealing assembly (200) as in claim 8 wherein the cable sealing member (220) is made of a

silicon based material having a flexibility range of A30-A50 on the Shore hardness scale.

10. A cable sealing assembly (200) as in any of the preceding claims wherein the protruding member (210) and the recessed member (230) are made of metal and the cable sealing member (220) is at least partly covered with a conductive layer configured to provide a low impedance path between the protruding member (210) and the recessed member (230) when the cable entry (115) is sealed.
11. A cable sealing assembly (200) as in any of the preceding claims wherein the protruding member (210) is firmly mounted to or being an integral part of the enclosure (110).
12. A cable sealing assembly (200) as in any of the preceding claims wherein the recessed member (230) is firmly mounted to or being an integral part of the detachable cover (120).
13. A cabinet (100) comprising a cable sealing assembly (200) as in any of the preceding claims wherein the detachable cover (120) is further configured to engage with the cable sealing assembly (200) so that the protruding member (210) and the recessed member (230) applies an even pressure (290) on the cable sealing member (220) when the cover (120) is mounted.



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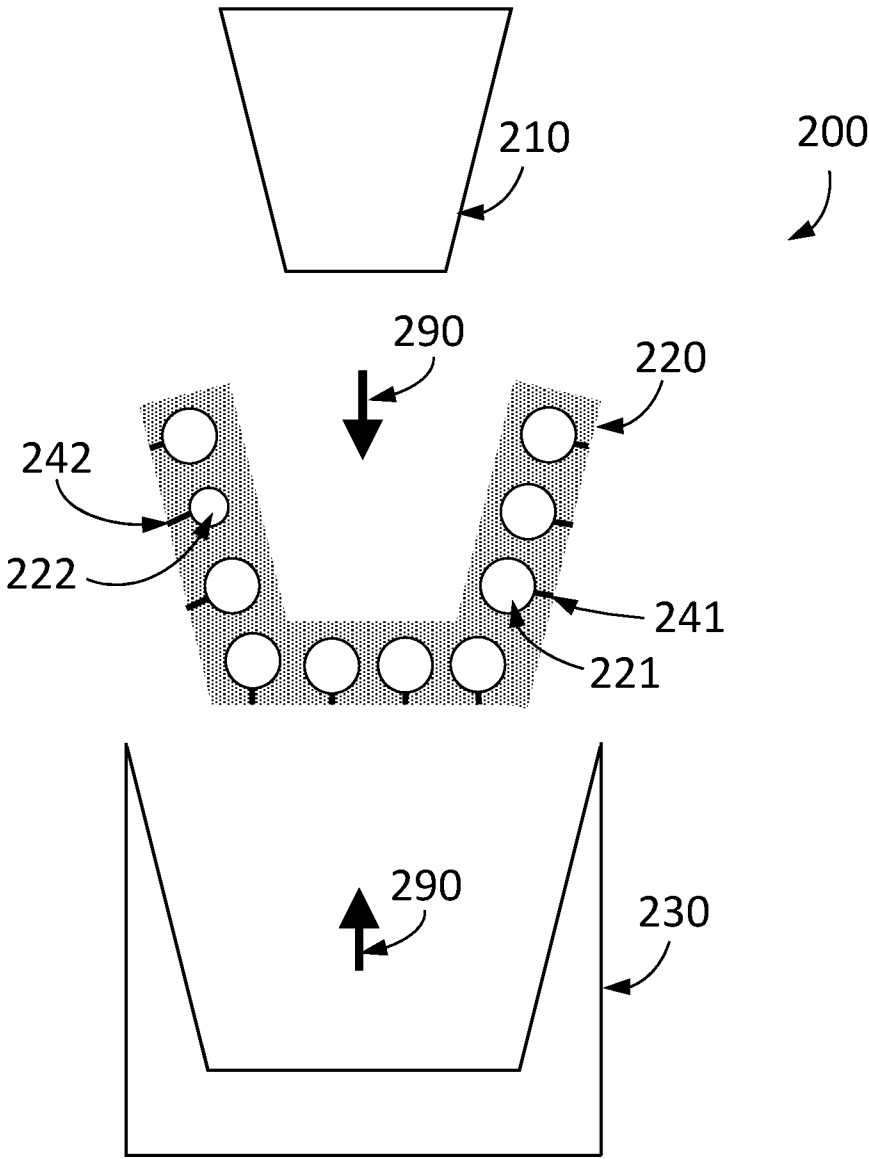


Figure 2

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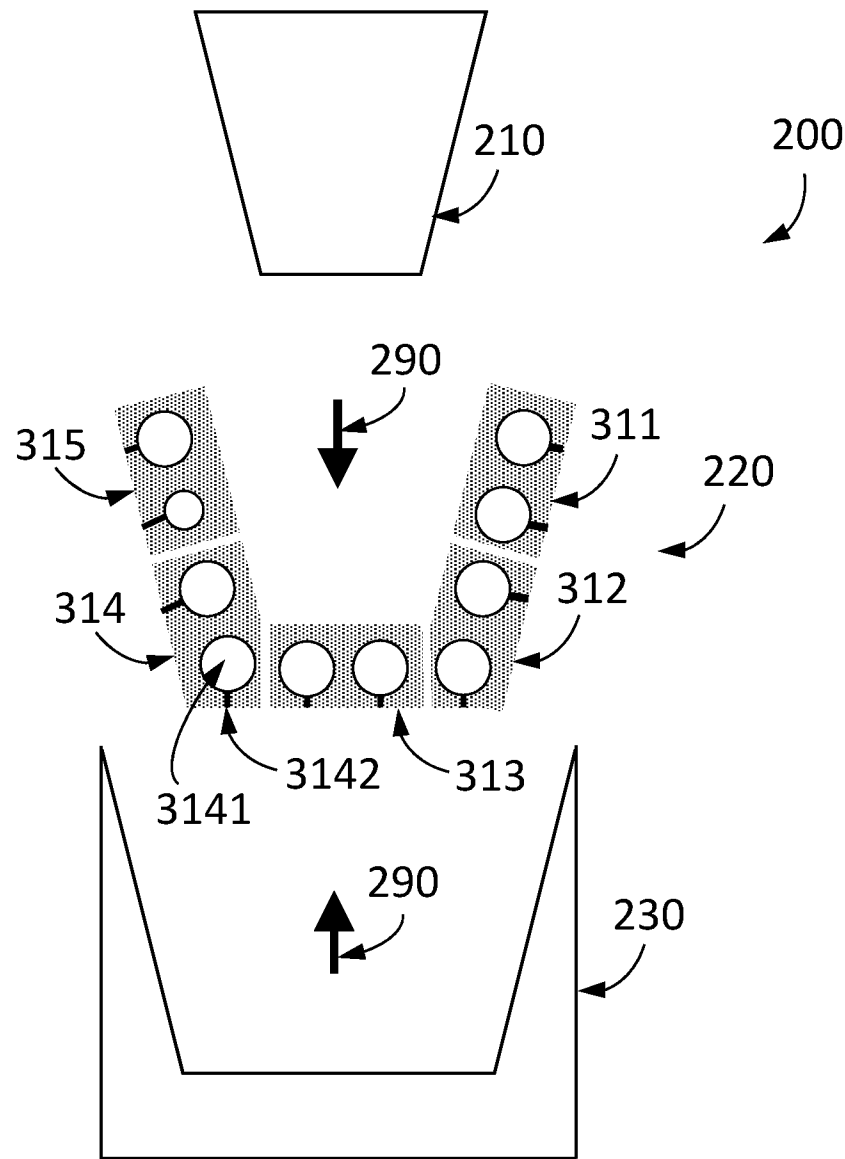


Figure 3

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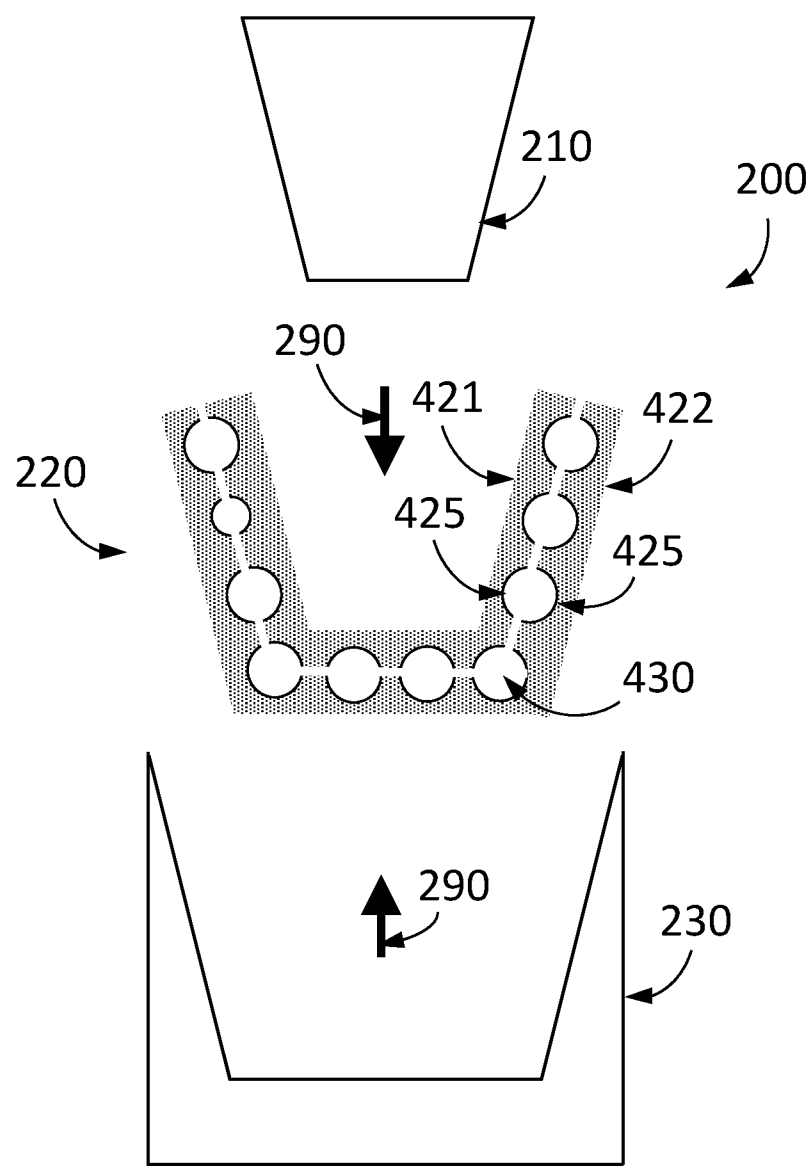


Figure 4

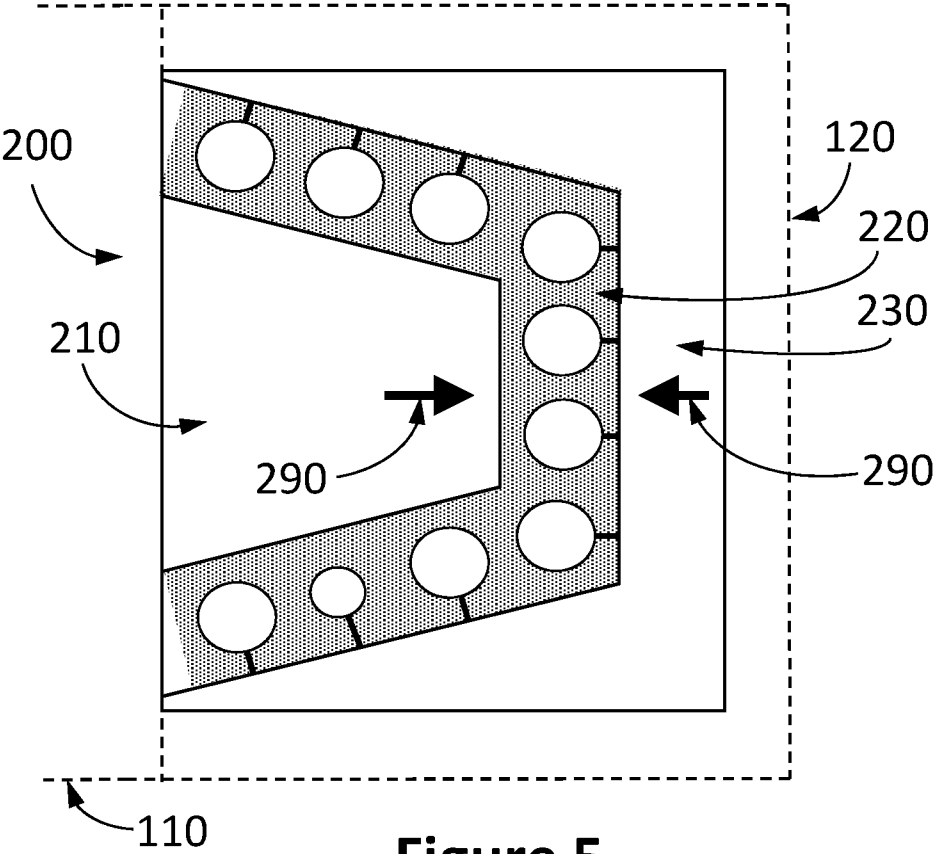


Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2017/051154

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05K5/02 H02B1/30 H02G3/22
ADD.

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)
H05K H02B H02G

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)

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	US 8 541 698 B2 (PERSCHON HELMUT [DE]; IRMER GUENTER [DE]; SICHERT GMBH BERTHOLD [DE]) 24 September 2013 (2013-09-24) cited in the application column 5, line 66 - column 9, line 30; figures 1a-5	1-13
A	US 2013/161090 A1 (NURMI AAPO [FI] ET AL) 27 June 2013 (2013-06-27) paragraphs [0007], [0028] - [0037]; figures 1-8	1-13
A	US 5 422 436 A (ZACHRAI JUERGEN [DE]) 6 June 1995 (1995-06-06) page 2, line 46 - page 4, line 2; figures 1-3	1-13
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

3 August 2018

Date of mailing of the international search report

13/08/2018

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/SE2017/051154

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 537 794 A1 (LOH RITTAL WERK GMBH CO [DE]) 15 June 1984 (1984-06-15) abstract; figures 1-5 -----	1-13

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/SE2017/051154

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 8541698	B2	24-09-2013	DE 102008012460 B3	22-10-2009
			DK 2272142 T3	30-06-2014
			EP 2272142 A1	12-01-2011
			IL 205646 A	31-03-2016
			US 2011080078 A1	07-04-2011
			WO 2009109568 A1	11-09-2009

US 2013161090	A1	27-06-2013	CN 103109427 A	15-05-2013
			EP 2586111 A1	01-05-2013
			US 2013161090 A1	27-06-2013
			WO 2011161319 A1	29-12-2011

US 5422436	A	06-06-1995	DE 4207281 C1	29-04-1993
			EP 0560119 A1	15-09-1993
			JP 2533052 B2	11-09-1996
			JP H0614420 A	21-01-1994
			US 5422436 A	06-06-1995

FR 2537794	A1	15-06-1984	DE 8235062 U1	09-06-1983
			FR 2537794 A1	15-06-1984
			GB 2134332 A	08-08-1984
			NL 8304282 A	02-07-1984
			SE 451784 B	26-10-1987
