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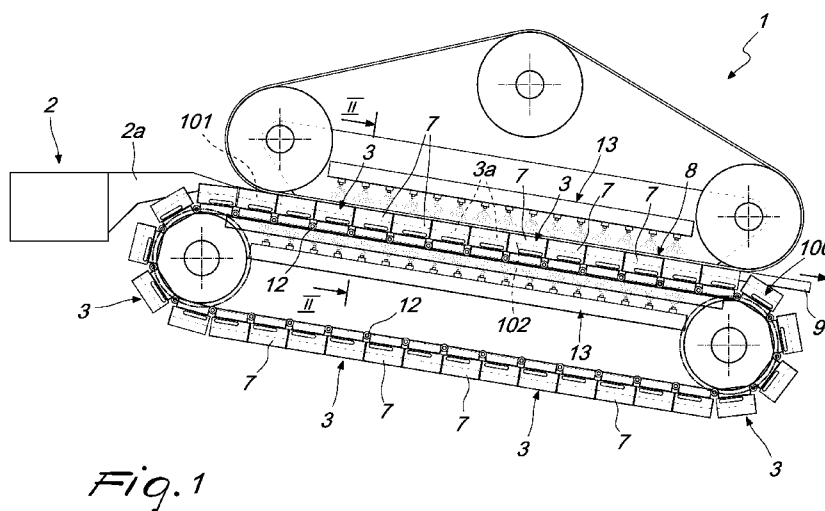
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(54) Title: APPARATUS FOR THE PRODUCTION BY CASTING OF METAL INGOTS



(57) Abstract: An apparatus (1) for the production, by casting, of metal ingots, which comprises a casting device (2) associated with at least one casting shell (3) that can move along a closed path (100), the casting shell (3) defining at least one containment receptacle (4) for the molten metal fed by the casting device (2); the casting shell (3) comprises at least one finned body (5) for the dissipation of the heat from the casting shell (3) by way of forced convection.

APPARATUS FOR THE PRODUCTION BY CASTING OF METAL INGOTS

The present invention relates to an apparatus for the production, by casting, and preferably by continuous casting, of metal ingots, and in particular of ingots of nonferrous metals such as, for example, primary aluminum, aluminum alloy, brass, zinc alloys, etc. .

Typically, all metals are extracted from mined minerals, or they are obtained by recycling scrap metal and, after various transitions, are made available in commercial form and reduced to suitable sizes.

10 The present invention relates to an apparatus for the production of ingots, i.e. of the format that is easy to handle, is especially suitable for re-melting, and has a weight comprised between a few kilograms and a few dozen kilograms.

The ingots are required, according to requirements of use, in various different sizes and they must have characteristics which are such as to ensure the desired quantity of molten metal.

One of the most commonly used techniques for producing ingots involves the use of a continuous casting machine which is provided with a movable casting shell composed of a plurality of segments, or casting bodies, which are arranged in succession, each with a segment of the casting shell defined with bottom and sides, and open on the sides directed toward the contiguous segments.

The segments are movable along a closed path which has at least one substantially rectilinear first segment at the casting region.

25 Downstream of the first segment, the closed path defines a second, cooling segment, also substantially rectilinear in extension, in which the segments are closed by a closure belt that faces, with a segment thereof, the second, cooling segment and is arranged on the opposite side with respect to the bottom of the shell.

30 Along the second, cooling segment are positioned means of cooling

the metal cast in the shell, which are constituted, for example, by nozzles for dispensing a cooling fluid that is adapted to strike, with the fluid, the belt element and the side walls and bottom of the segments that define the open shell.

5 At the end of the cooling segment, the path of the segments has a variation of direction for the progressive release of the casting shell by the metal bar that derives from the solidification of the molten metal.

Finally, downstream of the cooling segment in the direction of advancement of the metal bar, there is a station for cutting the bar obtained
10 into portions.

Likewise known is another type of apparatus for the production of ingots, which involves performing single castings, in open shells, which are arranged on a moving belt.

In this case, the non-continuous pouring of the metal carried out
15 individually, shell by shell, further reduces the speed of the apparatus in addition to presenting further criticalities owing to the fact that the filling of the individual shells is not always constant.

In this case also, the cooling of the ingots occurs by convection of a fluid on the outer surface of the individual shells.

20 The apparatuses described briefly above, although widely used, are not devoid of drawbacks, however.

In particular, in both cases the shells for cooling/solidification have a very limited heat exchange surface and this results in low solidification speeds and thus low hourly production.

25 The aim of the present invention is to solve the above mentioned problems and overcome the drawbacks, by providing an apparatus for the production, by casting, of metal ingots which makes it possible to appreciably increase hourly production.

Within this aim, an object of the invention is to provide an apparatus
30 that is easy to operate.

Another object of the present invention is to make available an apparatus for the production, by continuous casting, of metal ingots which is low cost so as to make its adoption advantageous from an economic viewpoint as well.

5 This aim and these and other objects which will become better apparent hereinafter are achieved by an apparatus for the production, by continuous casting, of metal ingots according to claim 1.

Further characteristics and advantages of the invention will become better apparent from the description of some preferred, but not exclusive,
10 embodiments of the apparatus according to the invention, which are illustrated by way of non-limiting example in the accompanying drawings wherein:

Figure 1 is a schematic side elevation view of a portion of the apparatus according to the invention;

15 Figure 2 is an enlarged cross-sectional view of a portion of the apparatus, taken along the line II-II in Figure 1;

Figure 3 is an exploded view of an embodiment of the casting body;

Figure 4 is a perspective view of a casting body;

Figure 5 is a view from below of the casting body shown in Figure 3;

20 Figure 6 is a side elevation view of the casting body;

Figure 7 is a front elevation view of the casting body;

Figure 8 is a schematic view from above of a second type of apparatus for the production of ingots;

Figure 9 is a cross-sectional view taken along the line IX-IX in Figure
25 8;

Figure 10 is a schematic view from above of a third type of apparatus for the production of ingots;

Figure 11 is a cross-sectional view taken along the line XI-XI in Figure 10.

30 With reference to the figures, the present invention relates to an

apparatus, generally designated by the reference numeral 1, for the production, by casting, of ingots and, in particular, of nonferrous metals.

The apparatus 1 comprises a casting device 2 associated with at least one casting shell 3.

5 The casting shell or shells 3 is/are movable along a closed path 100.

The casting shell or shells 3 defines/define at least one containment receptacle 4 for the molten metal fed by the casting device 2.

According to the present invention, the casting shell 3 comprises at least one finned body 5 for the dissipation of the heat from the casting shell
10 3 by way of forced convection.

Advantageously, the (or each) finned body 5 is associated stably with a respective mating portion 6 which is defined on the outer surface of the casting shell 3.

With particular reference to the embodiment shown in Figures 1 and
15 2, the casting shell 3 comprises a continuous casting device 2a.

In this case, the casting shell 3 comprises a plurality of casting bodies 7, which are arranged in succession and are movable along the closed path 100.

In particular, each casting body 7 defines a segment 3a, with bottom
20 7a and sides 7b, of the casting shell 3.

The segment 3a defined by each casting body 7 is open on the sides directed toward the contiguous casting bodies 7.

The casting bodies 7 are movable along the closed path 100.

Delving deeper into the details, the closed path 100 has a first segment
25 101, advantageously substantially rectilinear, which is arranged at the casting region and, downstream of the first segment 101, a second, cooling segment 102, substantially rectilinear, in which the casting bodies 7 are substantially aligned so as to define, with the respective bottoms 7a and the respective sides 7b, the casting shell 3.

30 The casting shell 3 thus is continuous, rectilinear and closed for at

least one segment of the closed path 100, downstream of the casting region, by closure means 8 at its side that is opposite with respect to the bottom.

The closed path 100 of the casting bodies 7 has, furthermore, conveniently downstream of the second, cooling segment 102, a variation of direction for the progressive release of the casting shell 3 by the metal bar 9 that derives from the solidification of the metal in the casting shell 3.

Typically, the apparatus 1 has, downstream of the casting shell 3 in the direction of advancement of the metal bar 9, a first cooling station, for example of the tunnel type.

10 Downstream of the first cooling station there is usually a cutter, for example of the rotating type, for the cutting, into ingots of the desired length, of the metal bar 9.

With reference to the embodiment described just above, it is possible for each casting body 7 to define at least one respective mating portion 6 with which to stably associate at least one respective finned body 5.

For the purposes of example, the (or each) finned body 5 is associated stably with the respective mating portion 6 by way of forced mating and/or by way of mutual fixing by way of screws 11.

Preferably, the (or each) finned body 5 is associated stably with the respective mating portion 6 by way of interposition of a heat-conducting paste 10.

Conveniently, the heat-conducting paste is of the adhesive type and, advantageously, is water-resistant.

25 In particular, it has been observed that, by using a heat-conducting adhesive paste 10, it becomes unnecessary to carry out mirror machining of the coupling portions 6 and of the surface of the finned body 5 which is designed to face toward the mating portion 6, with consequent reduction of costs.

Preferably, the mating portion 6 is defined at a portion of the outer surface of each casting body 7 that is designed to be directed downward

30

along the second, cooling segment 102.

The (or each) finned body 5 comprises a plurality of fins 5a which are mutually spaced apart.

With reference to the embodiment shown in the figures, the fins 5a are
5 arranged along a direction that is substantially parallel to the advancement direction of the casting shell 3 along the closed path 100.

Obviously, there is no reason why the fins 5a cannot be arranged at right angles to the advancement direction, or extend along different directions in order to obtain, for example, a so-called “snowflake”
10 arrangement.

According to a preferred embodiment, the finned body 5 is made of aluminum or copper.

Advantageously, the casting bodies 7 are made of copper.

The closure means 8 can be constituted by a belt element 8a.

15 The belt element 8a can move along a path that faces, with a segment thereof, at least one portion of the second, cooling segment 102.

The casting bodies 7 are connected to the mesh of a closed loop chain 12 and such chain 12 is wound around at least two pinions on mutually parallel axes.

20 Preferably, the second, cooling segment 102 is defined at the upper level of the chain 12.

The apparatus 1 is provided with cooling means, designated with the reference numeral 13, of the metal poured into the casting shell 3.

Delving deeper into the details, the cooling means 13 comprise a
25 plurality of nozzles 13a for dispensing a cooling fluid, which are adapted to strike the finned bodies 5 with the cooling fluid.

It should be noted that the subject matter of the present invention can equally effectively be applied to apparatuses for the production, by casting, of metal ingots, and specifically of non-ferrous metal, differently from the
30 apparatus described and illustrated in Figures 1 to 7.

For the purposes of example, the finned body 5 can also be associated with apparatuses of similar type to that described, but with the movable shell constituted by the casting bodies 7 wound on a wheel in order to provide, in this case also, a continuous casting bar 9.

5 There is no reason however why the same inventive concept cannot be used on non-continuous casting apparatuses.

For the purpose of example, Figures 8 and 9 show an apparatus 30 with casting bodies 7 arranged side by side and each defining a containment receptacle 4 which is already shaped like an ingot.

10 In this case, the casting device 2 feeds the quantity of molten metal required into the containment receptacle 4, on which a casting body 7 is defined.

The casting body 7 is associated, at its outer surface, with a finned body 5.

15 Figures 9 and 10 schematically show an apparatus 1 of the carousel type 40 which has a plurality of casting bodies 7 which each define a plurality of containment receptacles 4 for a respective ingot.

In this case also, the outer surface of the casting bodies 7 is associated with at least one finned body 5.

20 Operation of the apparatus 1 according to the invention is the following.

The molten metal is fed continuously into the crucible and, from the crucible, it is poured into the movable casting shell 3 defined by the casting bodies 7.

25 In the casting shell 3 the metal is cooled by means of the jets of fluid emitted by the dispensing nozzles 13a.

The presence of the finned bodies 5 on the casting shell 3 and, in particular, at each casting body 7, makes it possible to reduce the cooling times and, consequently, to increase the speed of the casting shell 3 and, 30 therefore, the productivity of the apparatus.

Furthermore it is possible to likewise reduce the length of the second, cooling segment 102 and, thus, the overall space occupation of the apparatus 1.

As is evident from the foregoing description, there is no reason why
5 finned bodies 5 cannot be used in apparatuses for the production of ingots which involve performing individual castings, in open shells, arranged on a moving belt.

In this case, the finned body or bodies 5 is/are associated with a respective mating portion 6 defined on the outer surface of an open casting
10 shell that defines a receptacle 4 which is shaped to that it corresponds to the ingot that it is desired to obtain.

In practice it has been found that the apparatus according to the invention fully achieves the intended aim and objects in that it makes it possible to reduce the cooling times of the metal poured into the casting
15 shell 3 thus increasing, effectively, the productivity.

All the characteristics of the invention, indicated above as advantageous, convenient or similar, may also be missing or be substituted by equivalent characteristics.

The individual characteristics set out in reference to general teachings
20 or to specific embodiments may all be present in other embodiments or may substitute characteristics in such embodiments.

In practice the materials employed, provided they are compatible with the specific use, and the dimensions and shapes, may be any according to requirements and to the state of the art.

Moreover, all the details may be substituted by other, technically
25 equivalent elements.

Where the technical features mentioned in any claim are followed by reference numerals and/or signs, those reference numerals and/or signs have been included for the sole purpose of increasing the intelligibility of the
30 claims and accordingly, such reference numerals and/or signs do not have

any limiting effect on the interpretation of each element identified by way of example by such reference numerals and/or signs.

CLAIMS

1. An apparatus (1) for the production, by casting, of metal ingots, which comprises a casting device (2) associated with at least one casting shell (3) that can move along a closed path (100), said casting shell (3) defining at least one containment receptacle (4) for the molten metal fed by said casting device (2), characterized in that said casting shell (3) comprises at least one finned body (5) for the dissipation of the heat from said casting shell (3) by way of forced convection, said at least one finned body (5) being associated stably with a respective mating portion (6) that is defined on the outer surface of said casting shell (3).

2. The apparatus (1) according to claim 1, characterized in that said casting device (2) comprises a continuous casting device (2a), said casting shell (3) comprising a plurality of casting bodies (7) arranged in succession, each one of said casting bodies (7) defining a segment (3a), with a bottom (7a) and sides (7b), of said casting shell (3), said segment (3a) being open on the sides directed toward the contiguous casting bodies (7), said casting bodies (7) being movable along said closed path (100), said closed path having a first segment (101) which is arranged at the casting region and, downstream of said first segment (101), a second, cooling segment (102) which is substantially rectilinear and in which said casting bodies (7) are substantially aligned so as to define, with the respective bottoms (7a) and the respective sides (7b), said continuous casting shell (3), which is rectilinear and closed for at least one segment of the path (100), downstream of the casting region, by closure means (8) at its side that is opposite with respect to the bottom, said closed path (100) of said casting bodies (7) having a variation of direction for the progressive release of said casting shell (3) by the metal bar (9) that derives from the solidification of the metal in said casting shell (3).

3. The apparatus (1) according to one or more of the preceding claims, characterized in that it comprises at least one finned body (5) which is

associated stably with a respective mating portion (6) defined on the outer surface of each casting body (7).

4. The apparatus (1) according to one or more of the preceding claims, characterized in that said finned body (5) is associated stably with the
5 respective mating portion (6) by way of the interposition of a heat-conducting adhesive paste (10).

5. The apparatus (1) according to one or more of the preceding claims, characterized in that said finned body (5) is associated stably with the respective mating portion (6) by way of forced mating and/or by way of
10 mutual fixing by way of screws (11).

6. The apparatus (1) according to one or more of the preceding claims, characterized in that said mating portion (6) is defined at a portion of the outer surface of said casting body (7) that is designed to be directed downward along said second, cooling segment (102).

15 7. The apparatus (1) according to one or more of the preceding claims, characterized in that it comprises a plurality of casting bodies (7), each of which defines at least one containment receptacle (4) which is shaped like an ingot, said finned body (5) being associated with the outer surface of said casting bodies (7).

20 8. The apparatus (1) according to one or more of the preceding claims, characterized in that said finned body (5) is made of aluminum or copper.

9. The apparatus (1) according to one or more of the preceding claims, characterized in that said casting bodies (7) are made of copper.

10. The apparatus (1) according to one or more of the preceding
25 claims, characterized in that said closure means (8) comprise a belt element (8a), which can move along a path that faces, with a segment thereof, at least one portion of said second, cooling segment (102).

11. The apparatus (1) according to one or more of the preceding claims, characterized in that it comprises means (13) for cooling the metal
30 cast into said casting shell (3).

12. The apparatus (1) according to one or more of the preceding claims, characterized in that said cooling means (13) comprise a plurality of nozzles (13a) for dispensing a cooling fluid, which are adapted to strike said finned bodies (5) with said cooling fluid.

5 13. The apparatus (1) according to one or more of the preceding claims, characterized in that it comprises a casting device for nonferrous metals.

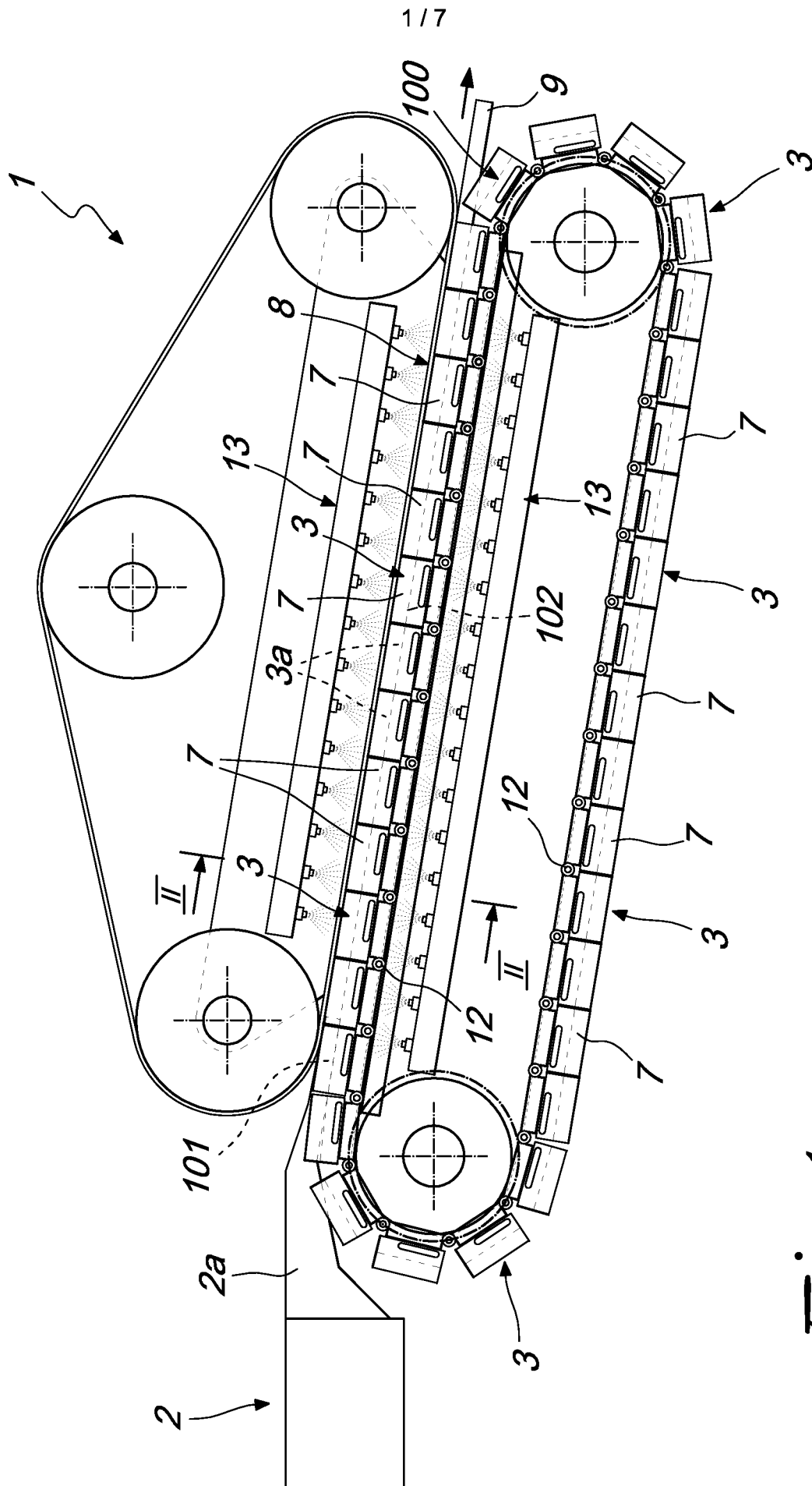


Fig. 1

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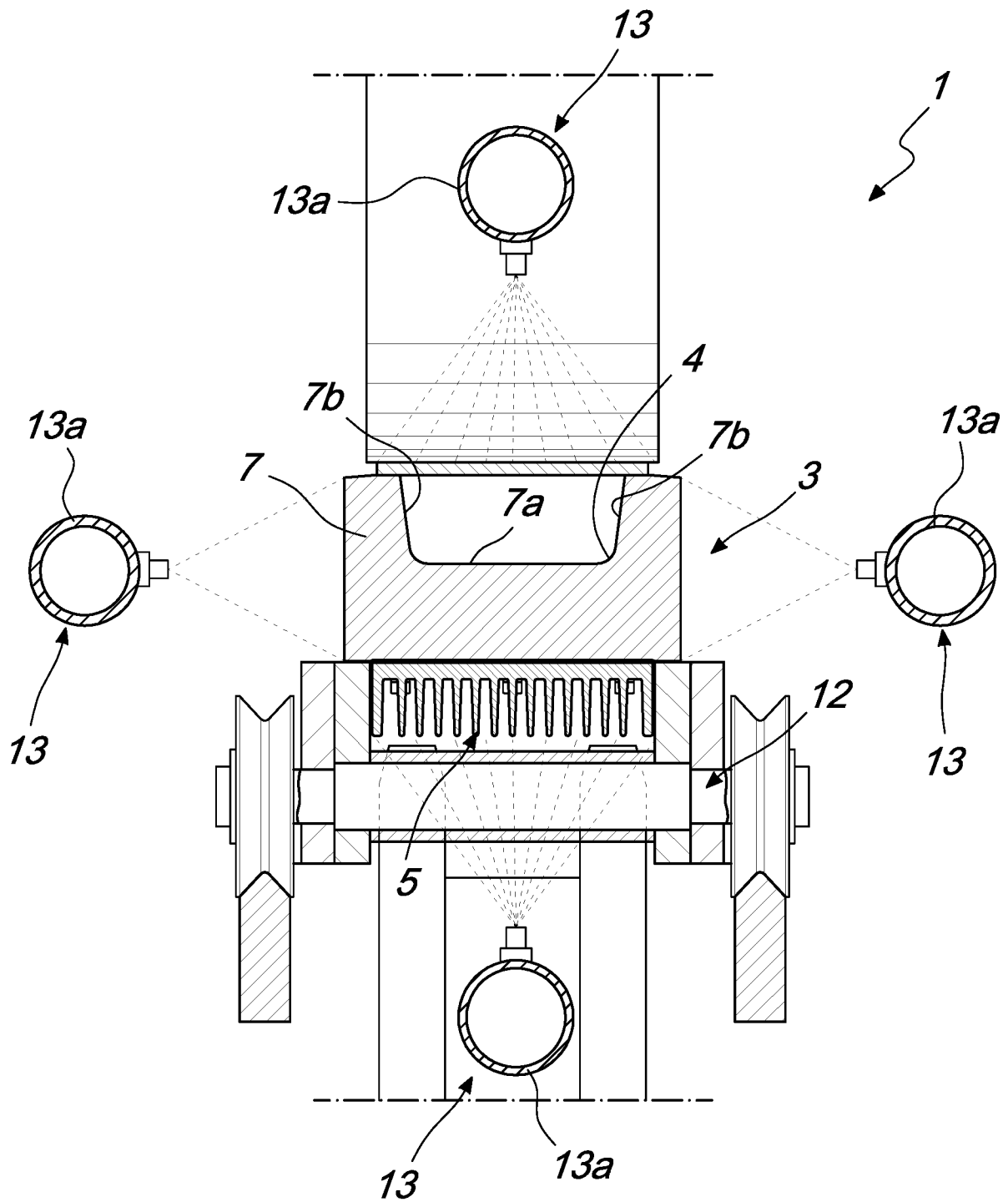


Fig. 2

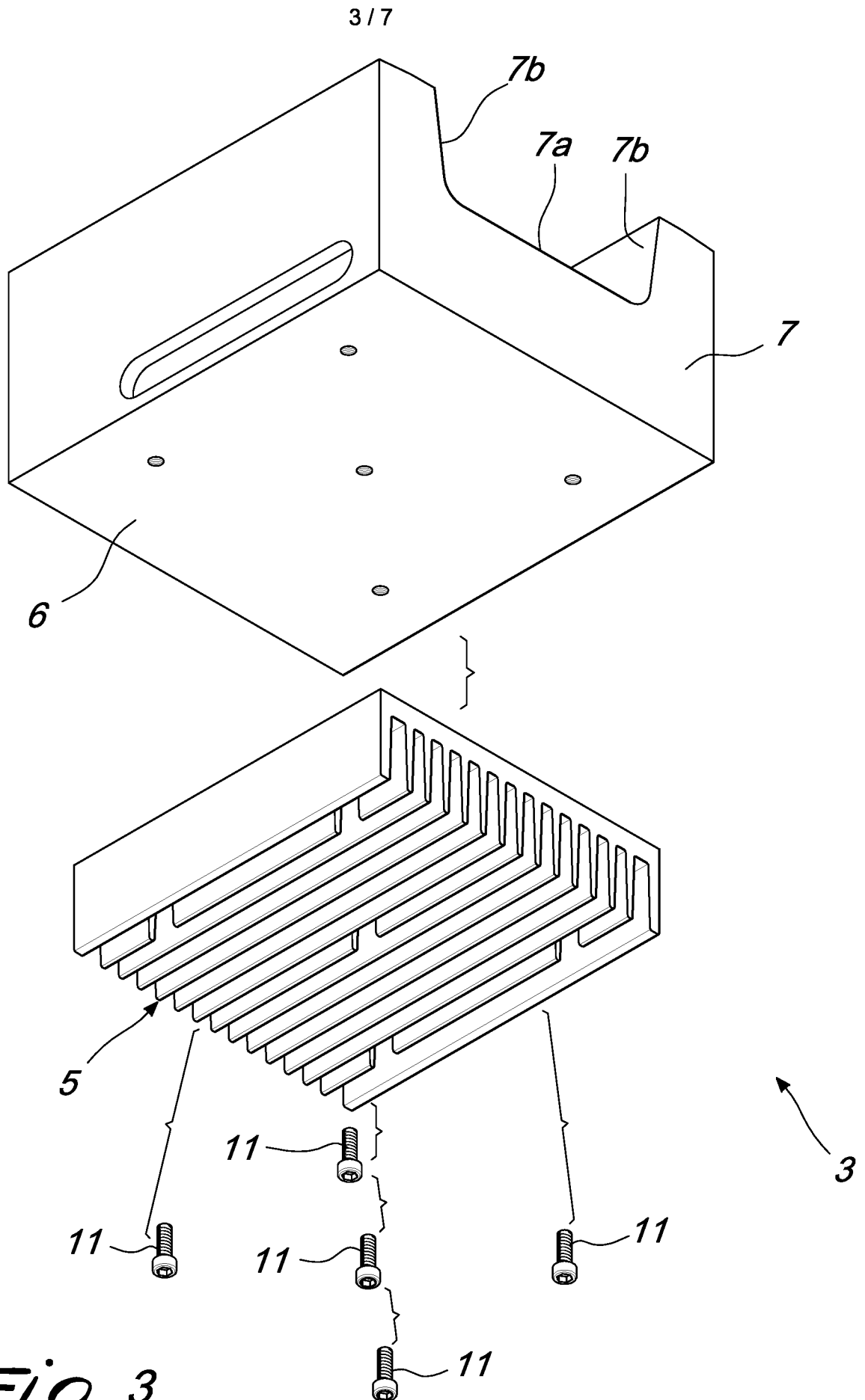
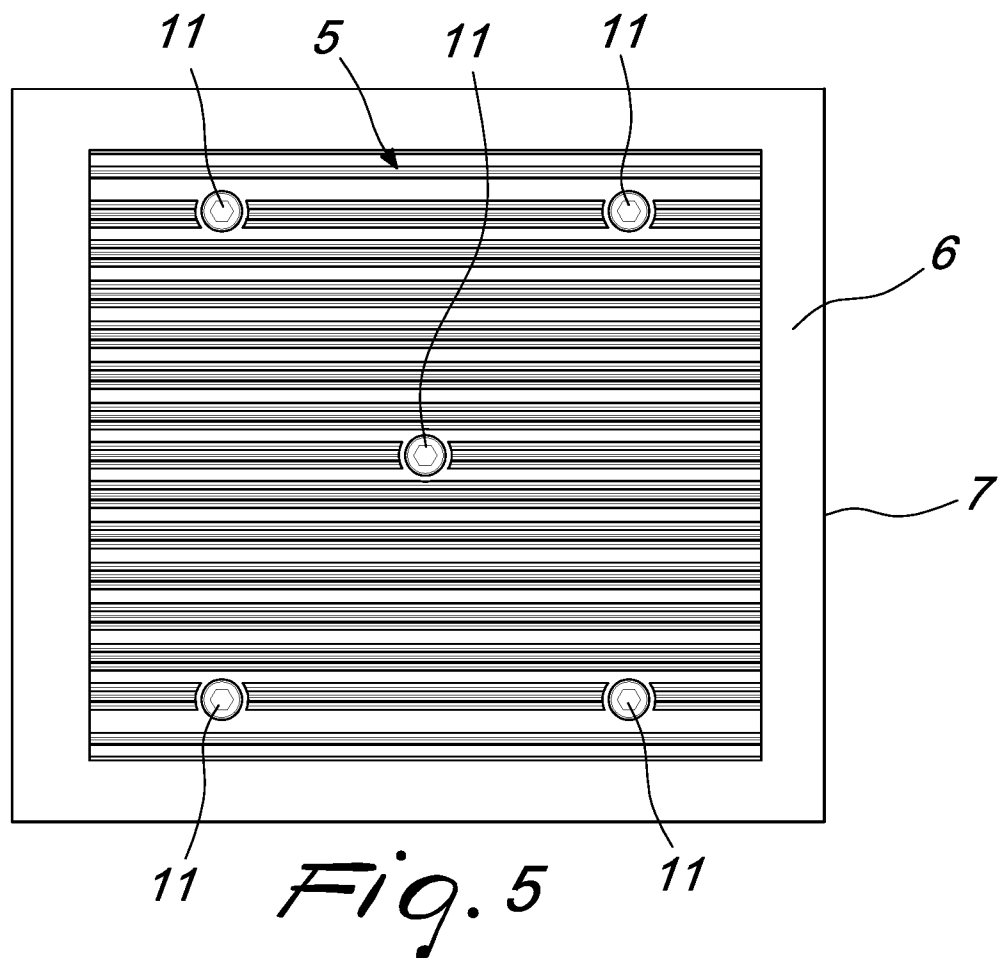
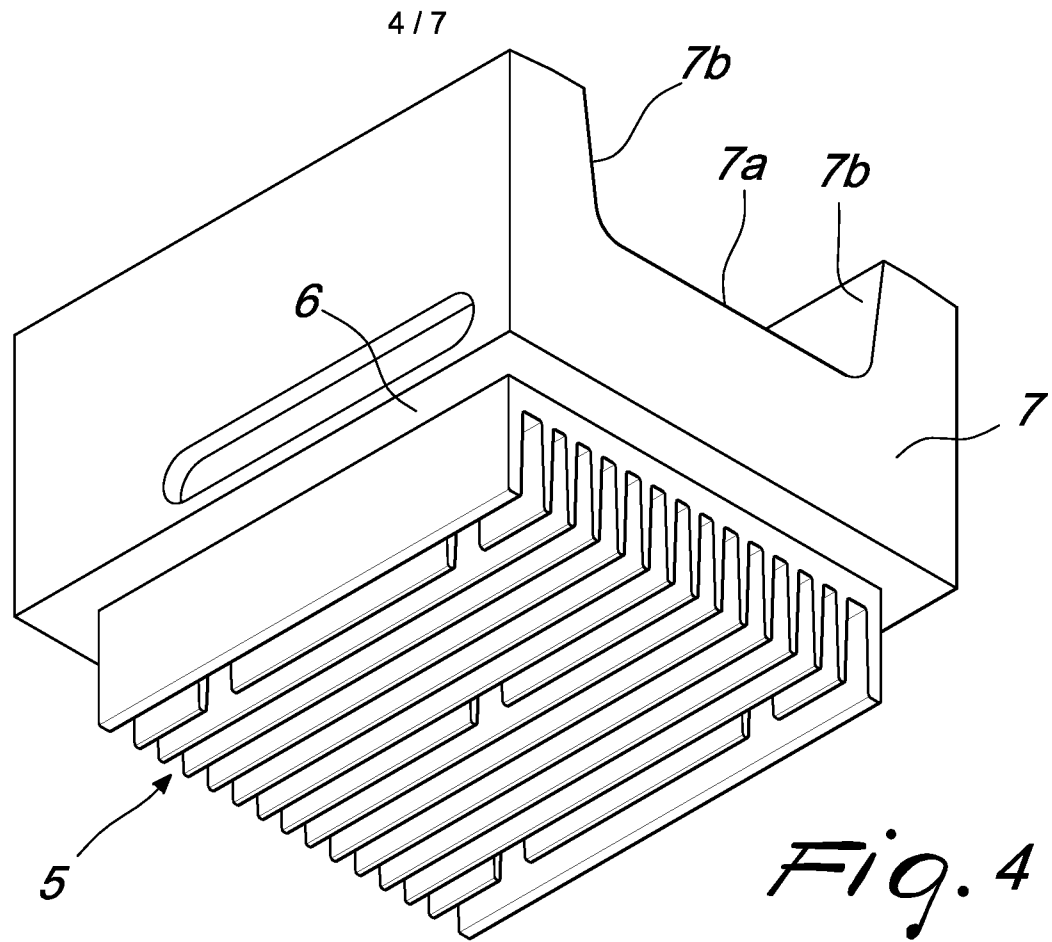
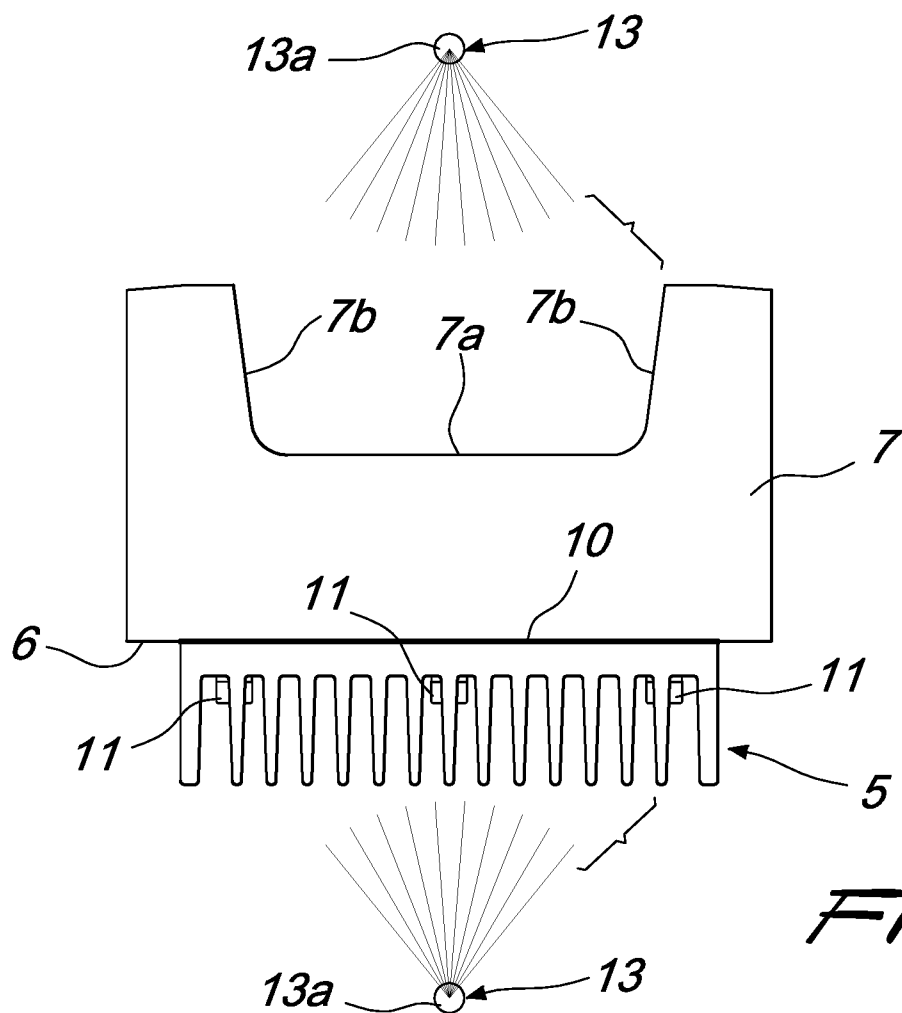
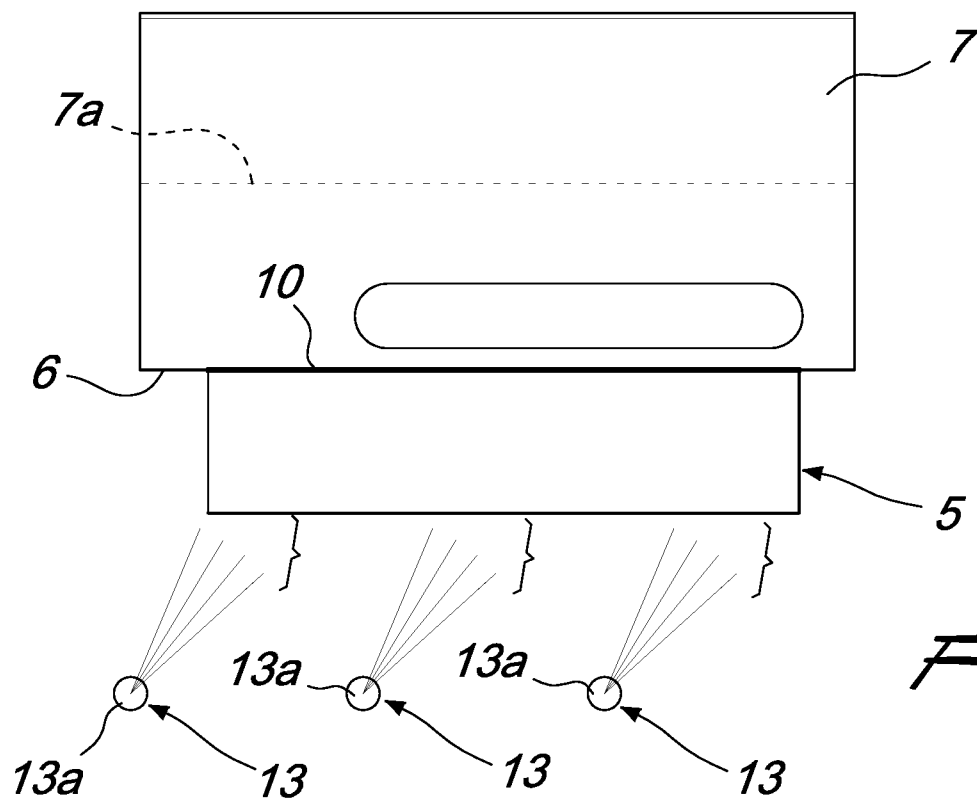


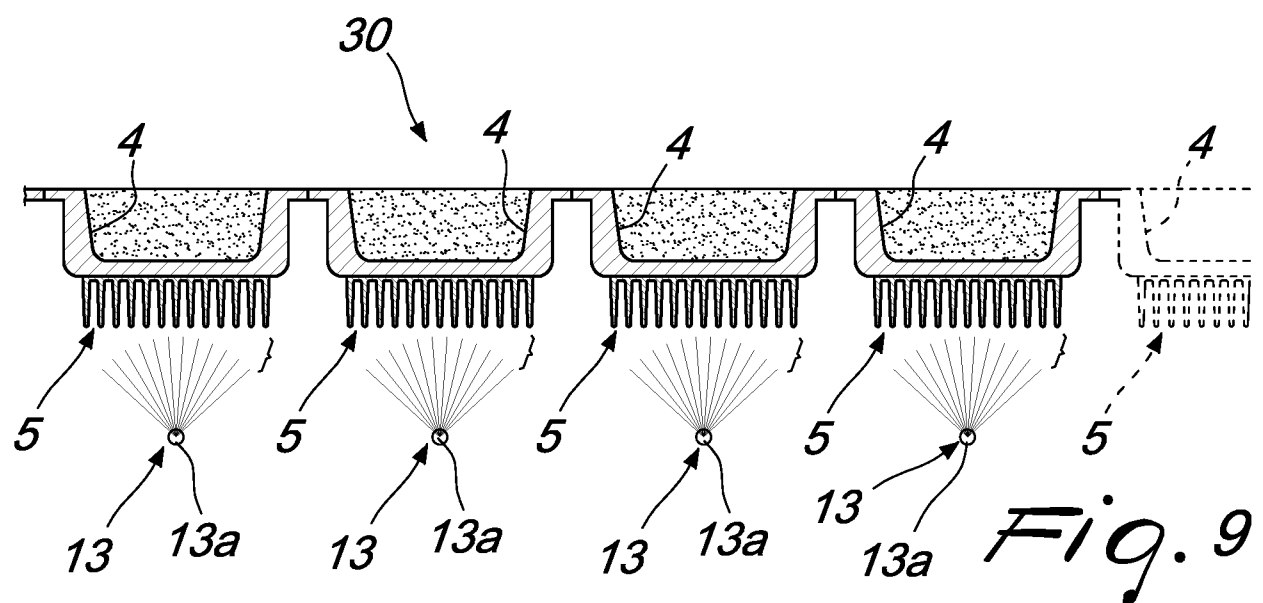
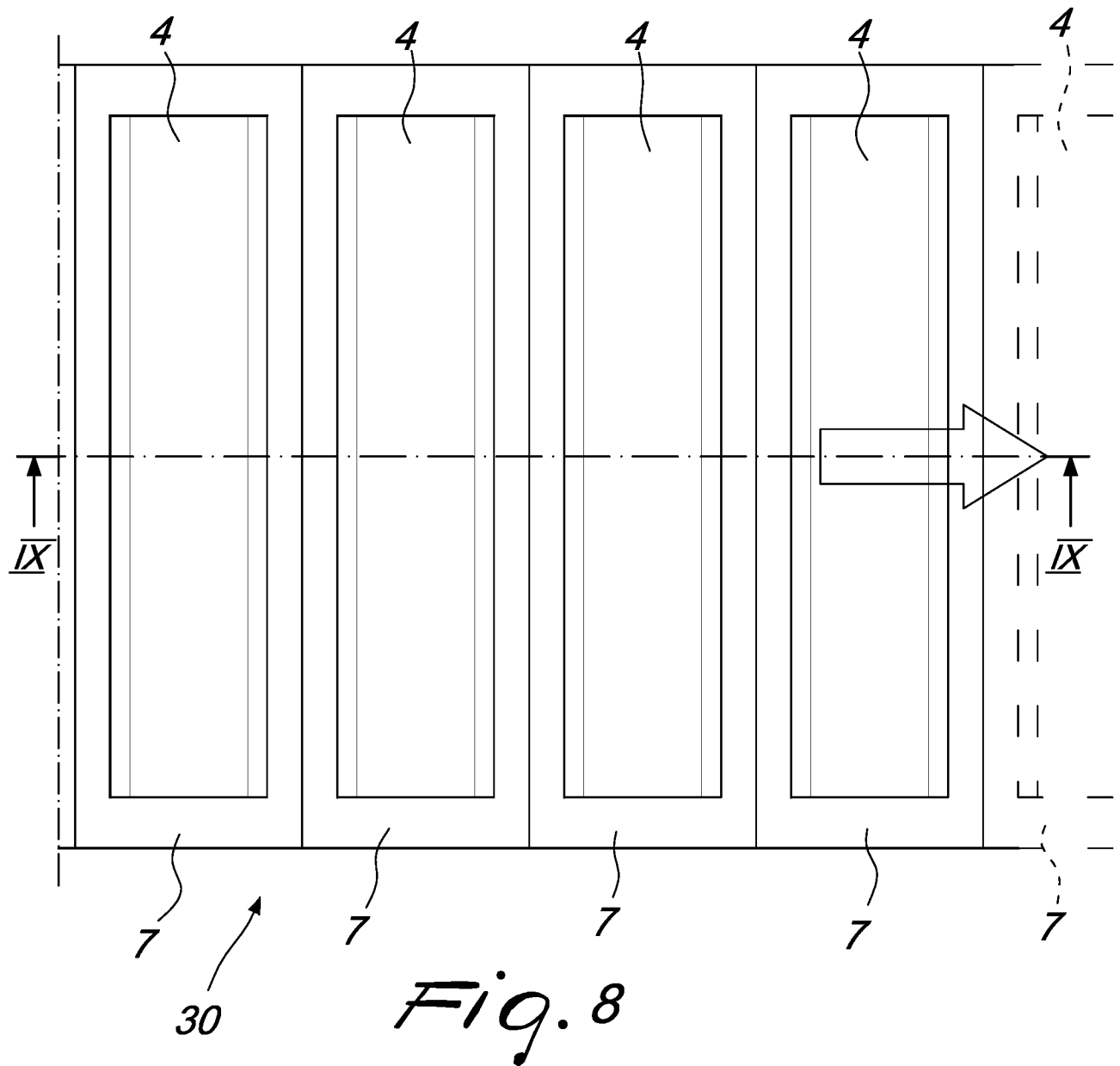
Fig. 3



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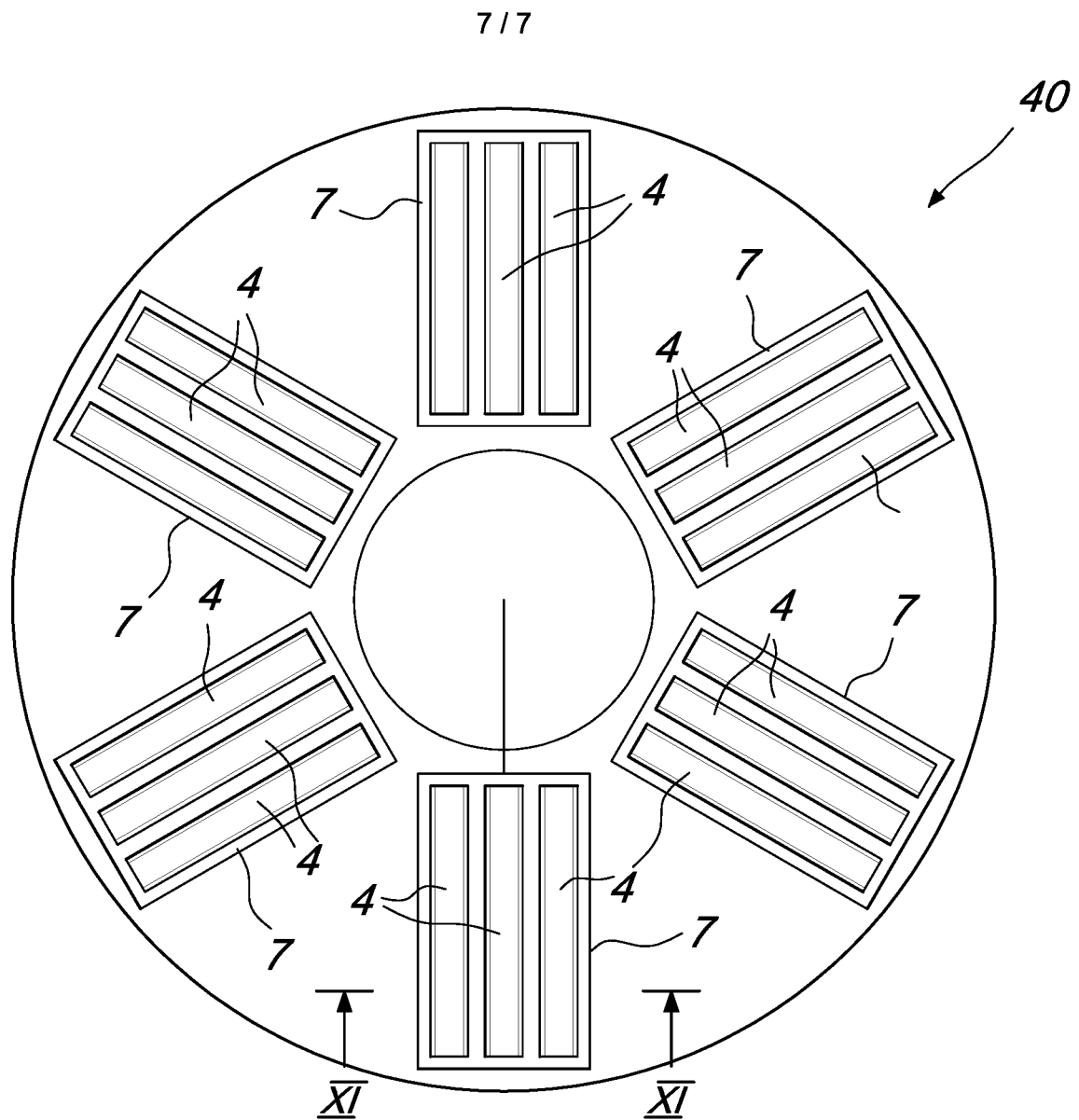


Fig. 10

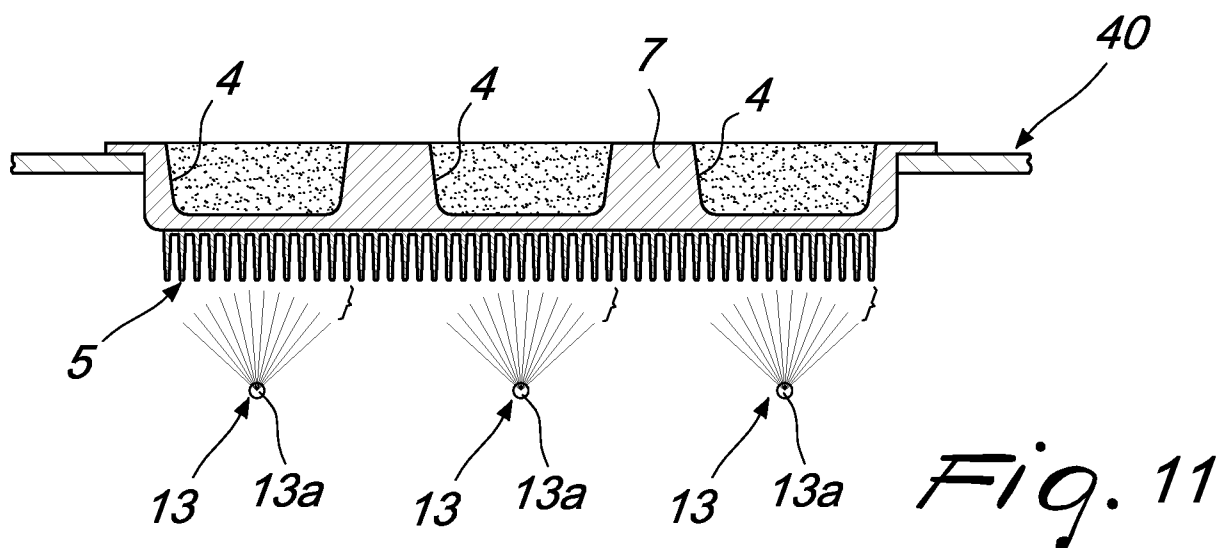


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/052810

A. CLASSIFICATION OF SUBJECT MATTER

INV. B22D5/04 B22D11/06 B22D5/02
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)
B22D

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.
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A	US 6 345 801 B1 (BOULET ALAIN RENAUD [CA]) 12 February 2002 (2002-02-12) the whole document -----	1-13
A	DE 688 836 C (DORTMUND HOERDER HUETTENVER AK) 4 March 1940 (1940-03-04) the whole document -----	1-13



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Date of the actual completion of the international search

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18/01/2016

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Baumgartner, Robin

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2015/052810

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