

**(12) PATENT**  
**(19) AUSTRALIAN PATENT OFFICE**

**(11) Application No. AU 199941744 B2**  
**(10) Patent No. 738054**

(54) Title  
**Stadium with arena such as an ice rink and surrounding stands for spectators,  
and channel element for a channel system in a stadium such as an ice rink and  
surrounding stands for spectators**

(51)<sup>7</sup> International Patent Classification(s)  
**E04H 003/10**

(21) Application No: **199941744**

(22) Application Date: **1999.05.20**

(87) WIPO No: **WO99/66153**

(30) Priority Data

|                 |                   |              |
|-----------------|-------------------|--------------|
| (31) Number     | (32) Date         | (33) Country |
| <b>19982521</b> | <b>1998.06.02</b> | <b>NO</b>    |

(43) Publication Date : **2000.01.05**

(43) Publication Journal Date : **2000.03.16**

(44) Accepted Journal Date : **2001.09.06**

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(56) Related Art  
**US 1634938**  
**US 3538719**  
**US 4513583**

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



41744/99

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

|                                                                      |    |                                                                                                                        |
|----------------------------------------------------------------------|----|------------------------------------------------------------------------------------------------------------------------|
| (51) International Patent Classification <sup>6</sup> :<br>E04H 3/10 | A1 | (11) International Publication Number: WO 99/66153<br>(43) International Publication Date: 23 December 1999 (23.12.99) |
|----------------------------------------------------------------------|----|------------------------------------------------------------------------------------------------------------------------|

(21) International Application Number: PCT/NO99/00161

(22) International Filing Date: 20 May 1999 (20.05.99)

(30) Priority Data:  
19982521 2 June 1998 (02.06.98) NO

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(81) Designated States: AE, 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, ZA,  
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**

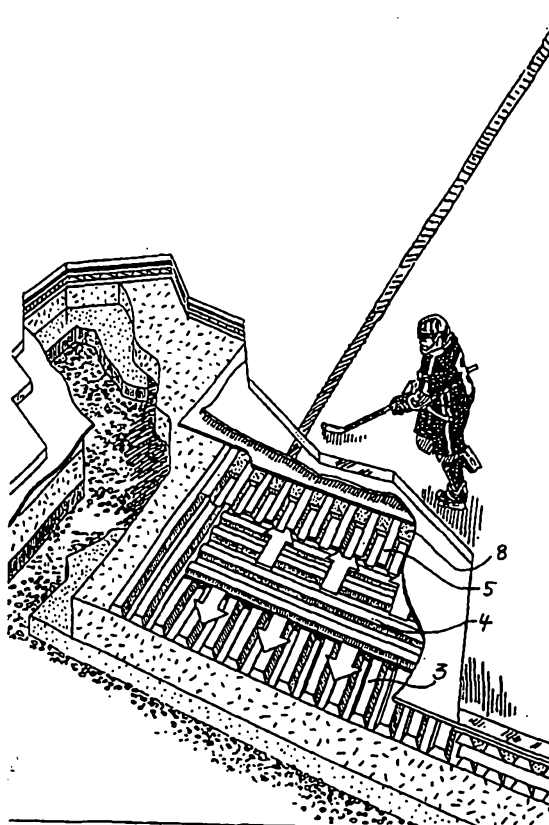
*With international search report.*

*In English translation (filed in Norwegian).*

(54) Title: STADIUM WITH ARENA SUCH AS AN ICE RINK AND SURROUNDING STANDS FOR SPECTATORS, AND  
CHANNEL ELEMENT FOR A CHANNEL SYSTEM IN A STADIUM SUCH AS AN ICE RINK AND SURROUNDING  
STANDS FOR SPECTATORS

**(57) Abstract**

The invention relates to a stadium with an arena (1) such as an ice rink, and surrounding stand (2) for spectators, and to a channel element for a channel system in the arena (1) and the surrounding stand (2). The arena (1) and the stands (2) comprise a channel system each, arranged so that air may be supplied and/or extracted for cooling or heating the arena (1) when the arena (1) is to be iced or de-iced, or so that the stands (2) may be used for heating and/or cooling of the stadium, respectively. Each channel system is made up of a number of channel elements consisting of at least three interconnected layers (3, 4, 5) of corrugated sheet material. The layers (3, 4, 5) are placed at angles in proportion to each other in such a way that corrugations of layers placed one above the other are preferably mutually perpendicular. Thereby channels are formed by the corrugations of the layers (3, 4, 5). The channels are interconnected by the intermediate layer (4) being formed with a number of holes (6) extending transversely to, and preferably in a plane through, the mid portion of the layer (4), so that air at a temperature providing heating and/or cooling may be taken through the formed channel system in a controlled manner.



STADIUM WITH ARENA SUCH AS AN ICE RINK AND SURROUNDING STANDS FOR SPECTATORS, AND CHANNEL ELEMENT FOR A CHANNEL SYSTEM IN A STADIUM SUCH AS AN ICE RINK AND SURROUNDING STANDS FOR SPECTATORS

- 5 The invention relates to a stadium with arena such as an ice rink and surrounding stand for spectators, and to a channel element for a channel system in a stadium with arena such as an ice rink and surrounding stand for spectators.

In known stadiums the icing is commonly done by means of a  
10 refrigerating plant with refrigerating fluid running in a pipe system underneath the floor surface of the arena. The heating and/or the cooling of the stadium is often done by air at a desired temperature being supplied through channels above the stands. A drawback of such dual solutions is that  
15 separate systems are required for making or removing ice on/from the arena, and heating and/or cooling the stadium, respectively. This costs money, both in connection with the building of the stadium, and in subsequent running and maintenance. Likewise, such dual solutions provide little  
20 possibility of cost-effective utilization of the surplus energy created in the respective part of the stadium. Another

drawback is that it takes a very long time to melt the ice again, if the arena is to be used for purposes for which there is no need for ice. Further drawbacks follow in that the air used for heating or cooling, is supplied in channels which are normally located close to the ceiling of the stadium. This involves, i.a., that the air must have a higher temperature than if it were supplied more at the level of the spectators, it must be supplied at a certain speed which may interfere with the activity on the arena, and space must be provided for the channels. Another extremely problematic condition is the pollution that hazardous chemicals in the coolant may cause, in case of a leak in the pipes.

An object of the present invention is to provide a more simple and more cost-effective way of building, running and maintaining the systems necessary for quick icing or de-icing of the arena, or for providing heating and/or cooling of the stadium, respectively. Other objects are to take care of the surplus energy gained in the different parts of the stadium, in a more convenient manner. Besides, it is achieved that the need for energy for the heating or cooling of air, decreases by the air instead being used for heating or cooling the stand themselves. Additionally, the use of hazardous chemicals which were earlier necessary in making the ice, may be avoided.

The above object is realised by the arena and the stand of the present stadium comprising separate channel systems. Each channel system is arranged so, that air may be supplied and/or extracted when ice is being made on, or removed from, the arena, or when the stand are used for heating and/or cooling the stadium, respectively. The channel system is made up of a number of channel elements consisting of at least

three interconnected layers of corrugated sheet material. The layers are placed at angles in such a way that corrugations of layers placed one above the other, preferably are mutually perpendicular, and thereby channels are formed by the corrugations of the layers. The channels are connected by the intermediate layer being formed with a number of holes extending transversely to, and preferably in a plane through, the mid portion of the layer, so that air at a temperature adjusted to enable icing or de-icing of the arena, heating and/or cooling of the stadium, respectively, may be taken through the formed channel system in a controlled manner. In addition to the above stadium, the invention also relates to channel elements which are necessary in order to provide the respective channel systems of the arena and the stand. Other advantageous details of the invention will appear from the following part of the specification and the dependent claims.

Referring now to the accompanying figures, preferred, non-limiting embodiments of the invention will now be explained in detail.

Fig. 1 shows a view of the present stadium in which some important details are described further;

Fig. 2 shows a schematic view of the arena and the stand;

Fig. 3 shows a section describing the configuration of a possible floor construction of the arena;

Fig. 4 shows a section of the channel element itself with the different layers of corrugated sheet material;

Fig. 5 shows a vertical section through the stands, in which are shown stand elements on an underlying beam provided with channels for supplying and/or extracting air from each channel element;

5 Fig. 6 shows a vertical section showing in further detail how the stand and some pertaining parts can be joined;

Fig. 7 shows stand elements extending in straight line and curved line, and with a number of stand elements of the straight-line type joined together for the surface forming  
10 the arena; and

Fig. 8 shows a schematic section through a possible floor construction of the arena with indication of a convenient distribution of temperatures of the channel system, ice and room temperature near the ice surface.

15 The present stadium comprises an arena 1 in the form of an ice rink with surrounding stand 2 for spectators. The arena 1 as well as the stand 2 are provided with separate channel systems arranged for the supply and/or extraction of air. The air temperature must be such that the arena 1 is cooled or  
20 heated when icing or de-icing is to take place or the stand 2 is to be heated and/or cooled, respectively, so that the stadium achieves the temperature expected by the spectators. Each channel system is made up of a number of channel elements consisting of at least three interconnected layers  
25 3, 4, 5 of corrugated sheet material. The layers 3, 4, 5 are placed at an angle in such a way that corrugations of layers, one above the other, are preferably mutually perpendicular. Thereby channels are formed from the corrugations of the layers 3, 4, 5, and the channels are interconnected by the

intermediate layer 4 being formed with a number of holes 6. The holes 6 extend transversely to, and preferably in a plane through, the mid portion of the layer 4, so that air at the appropriate temperature may be taken through the formed channel system in a controlled manner.

A person skilled in the art will, without problems, connect the channel system of the arena 1 to the channel system of the stand 2, for example by means of a different type of channels. Air which has obtained an increased temperature through the cooling of the arena 1, may thus be used for heating the stand 2, so that the stadium achieves a desired room temperature. Likewise, air meant for the channel system of the stand 2, may easily be supplied and/or extracted through channels 9, 10 in the underlying parts 11 carrying the stand 2. The channel 10 may for instance be a two-part pipe element extending between the channel 9 in the underlying carrying part 11 and the channel element of the stand.

The channel element of the stand 2 is advantageously embedded in the stand element 12 of e.g. concrete, and the channel element is embedded in such a way that corrugations in the upper layer 5 are filled to a level at least at the height of the corrugation ridges. The stand elements 12 may extend in a straight line or curved line, respectively, depending on whether they are to be used along a longitudinal side or in a bend of the arena 1, respectively. The stand elements 12 may be equipped with suitable connecting means along at least one side edge, so that stand elements 12 of a straight-line extent may be connected to form both a channel system and a floor surface of the arena 1. The channel elements may then

be connected by for example horizontally extending pipe elements.

The different layers of the channel element may be mutually connected at points of contact between corrugation valleys and ridges by means of popping, welding, gluing, screwing or similar. The walls of the corrugations of the layers 3, 5, facing the filling 8, may with advantage be formed with embossings 7 projecting either from or into the wall, so that the co-operation between the filling 8 is the best possible one. Besides, the channel element may be equipped with at least one horizontally and/or vertically extending channel 10 such as a pipe element. The channel element may thus be connected to the channel elements of adjacent stand elements 12 or to at least one underlying channel 9 in a carrying part 11 of the stand 2, possibly in channels under the arena 1 when the stand element is used to provide the channel system of the arena 1.

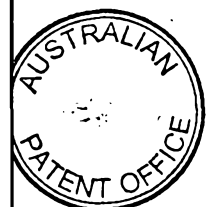
The configuration of the floor construction of the arena 1 and the embedding of the channel system therein, may, depending on the functional requirements following from the use of the arena, be done in far more ways than what has been described in the above.

It will not be described any further how air is provided for the respective channel systems, since this is not part of the present invention. However, in Fig. 8 is shown a convenient distribution of temperatures of the channel system, ice surface and the above room temperature. Cooling or heating of the arena 1, heating and/or cooling of the stadium, respectively, takes place by utilization of the difference in temperature of the air in the channel system of the arena 1

and the stand 2, respectively. Thereby is achieved that the arena 1 gets a temperature which allows icing or de-icing of the arena 1. Likewise, depending on whether heating or cooling is to take place, the stand 2 will contribute to the room temperature of the stadium facilities being changed to a desired level. It should be mentioned in particular, that since the spectators visit a stand 2 with increased or reduced temperature, the heating and cooling may take place with less difference in temperature between the supplied air and the stadium than what has been usual in conventional air plants.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A stadium with arena, such as an ice rink, and surrounding stand for spectators, characterized in that the arena and the stand comprise a channel system each, arranged for air to be supplied and/or extracted for cooling or heating the arena when the arena is to be iced or de-iced, or for the stand to be used for heating and/or cooling of the stadium facilities, respectively, in which each channel system is made up of a number of channel elements consisting of at least three interconnected layers of corrugated sheet material, the layers being placed at angles in such a way that corrugations of layers placed one above the other are preferably mutually perpendicular, so that channels are formed by the corrugations of the layers, and in which the intermediate layer is formed with a number of holes extending transversely to the mid portion of the intermediate layer, so that air at a temperature providing heating and/or cooling may be taken through the formed channel system in a controlled manner.
2. A stadium according to claim 1, characterized in that the channel system of the arena is connected with the channel system of the stand, such as by means of channels, so that air which for instance has obtained an increased temperature during the cooling of the arena, can be used for heating the stadium.
3. A stadium according to any one of the preceding claims, characterized in that air for the channel system of the stand is supplied and/or extracted through at least one channel in the underlying parts carrying the stands.
4. A stadium according to any one of the preceding claims, characterized in that channel elements of the stand are embedded in stand elements.



5. A stadium according to claim 4, characterized in that the channel element is embedded in such a way that corrugations of the upper layer are filled to a level at least at the height of the ridges of the corrugations.

6. A stadium according to claim 4, characterized in that the stand element is formed with a straight-line or curved line extent, so that it may be used along a longitudinal side and a bend, respectively, of the arena.

7. A stadium according to claim 6, characterized in that at least the stand element of straight-line extent is formed with connecting means along at least one side edge, so that the stand elements may be mutually connected to form the channel system and possibly the floor area of the arena.

8. A stadium according to claim 6 or 7, characterized in that the channel element has at least one horizontally and/or vertically extending channel such as a pipe element arranged thereto, so that the channel element may be connected to the channel element of adjacent stand elements and/or to at least one underlying channel of a carrying part for the stand or the arena.

9. A channel element for a channel system of a stadium with arena such as an ice rink, and surrounding stand for spectators, characterized in that the channel element is included in a channel system which is arranged so, that air can be supplied and/or extracted for cooling or heating the arena for the icing or de-icing of the arena, or so that the stand can be used for heating and/or cooling the stadium, respectively, in which the channel system is made up of a number of channel elements consisting of at least three interconnected layers of corrugated sheet material, the layers being placed at



angles in such a way that corrugations of layers placed one above the other, are preferably mutually perpendicular, so that channels are formed by the corrugations of the layers and whereby the intermediate layer is formed with a number of holes extending transversely to the mid portion of the intermediate layer, so that air at a temperature providing heating and/or cooling may be taken through the formed channel system in a controlled manner.

10. A channel element according to claim 9, characterized in that the layers are mutually connected at points of contact between the ridges and valleys of the corrugations by means of popping, welding, gluing, screwing or similar.

11. A channel element according to any one of the preceding claims 9-10, characterized in that the channel element is embedded in a filling of e.g. concrete to a level at least up to the ridges of the corrugations of the upper sheet layer.

12. A channel element according to claim 11, characterized in that the corrugation wall of the layers facing the filling is formed with embossings projecting either from or into the wall of the corrugations.

13. A channel element according to any one of the preceding claims 9-12, characterized in that the channel element has at least one horizontally and/or vertically extending channel such as a pipe element arranged thereto, so that the channel element may be connected with channel element of adjacent stand elements and/or with at least one underlying channel of a carrying part for the stand or the arena.

14. A stadium according to claim 1 wherein the holes



of the intermediate layer extend transversely in a plane through the mid portion of the intermediate layer.

15. A stadium according to claim 4 wherein stand  
5 elements are formed from concrete.

16. A channel element according to claim 9 wherein  
the holes in the intermediate layer extend transversely in  
a plane through the mid portion of the intermediate layer.

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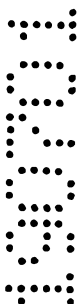
Dated this 18th day of July 2001

VOLSTAD ENERGY AS

By their Patent Attorneys

GRIFFITH HACK

15 Fellows Institute of Patent and  
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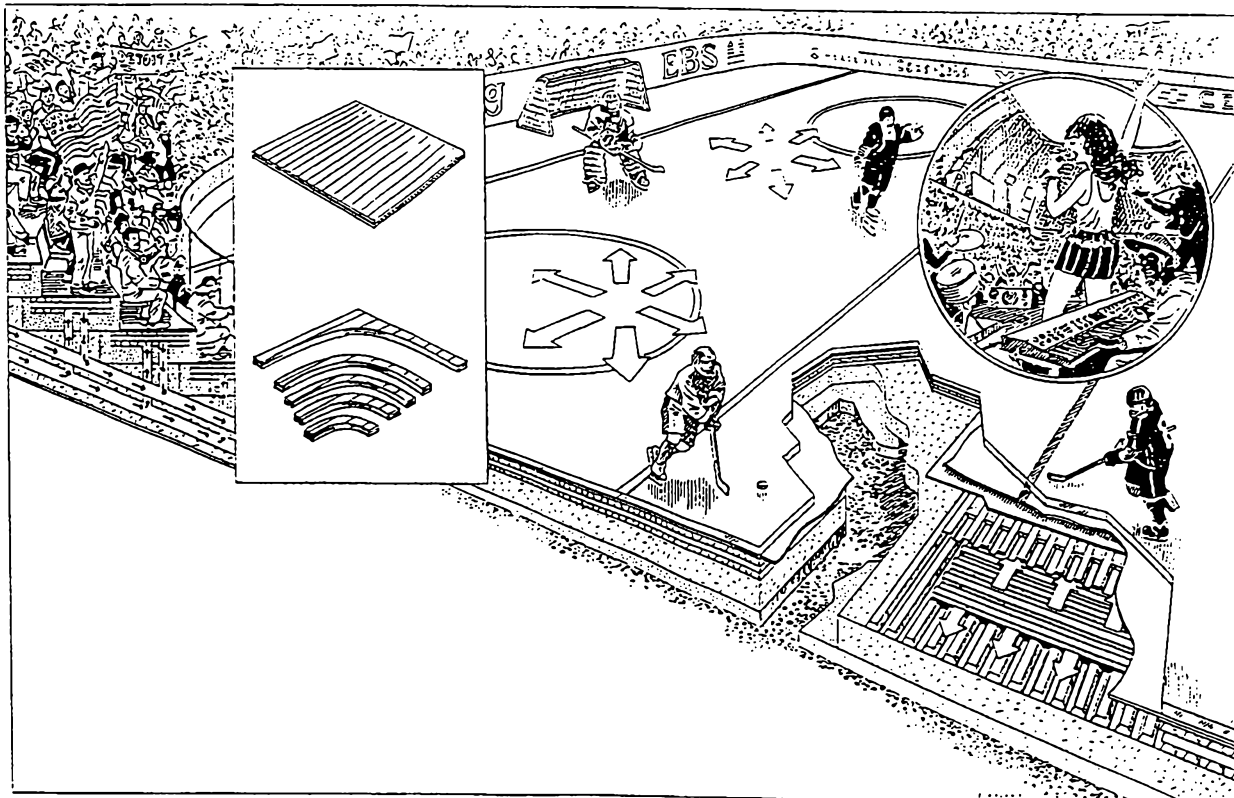


FIG. 1

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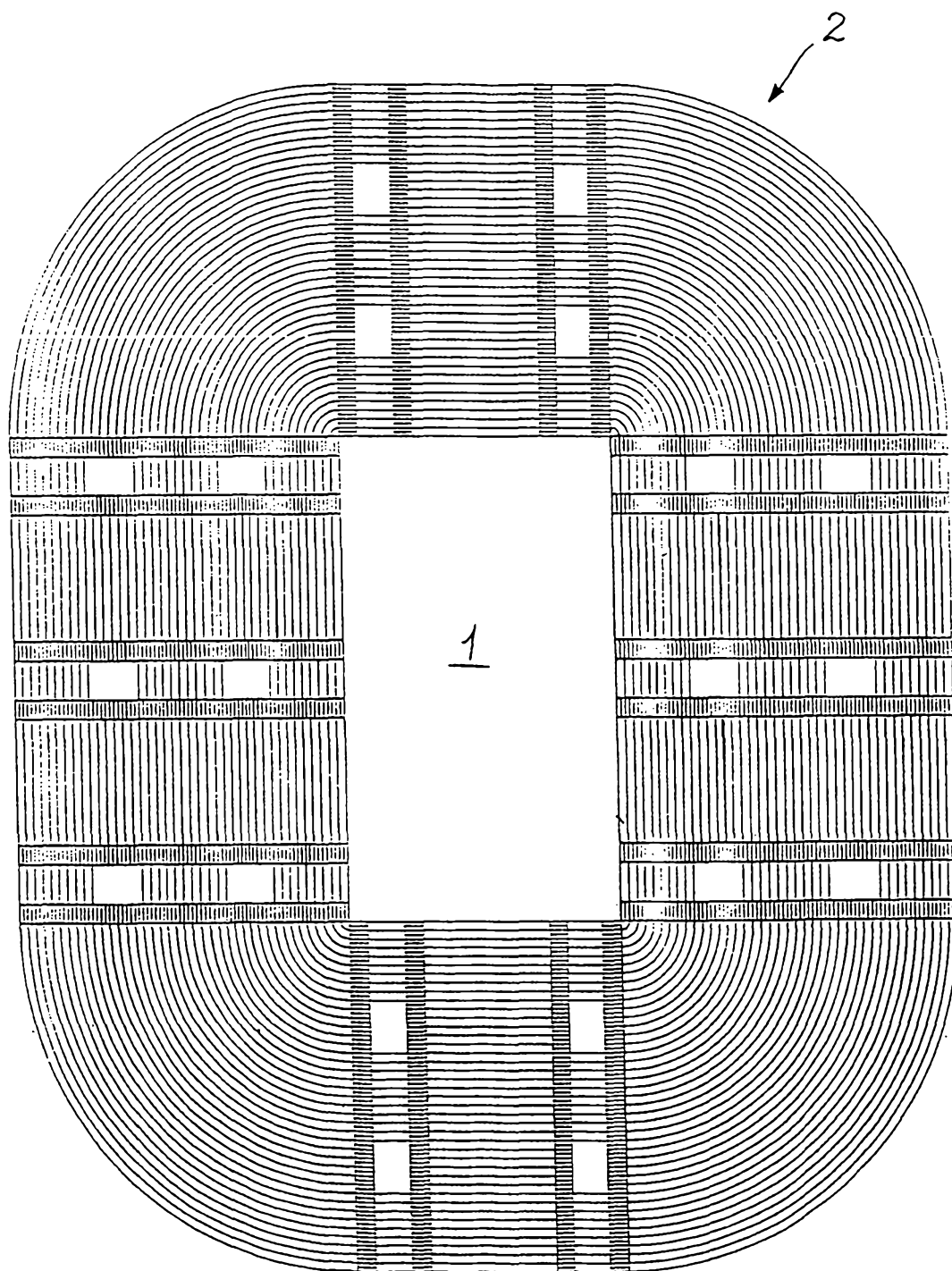


FIG.2

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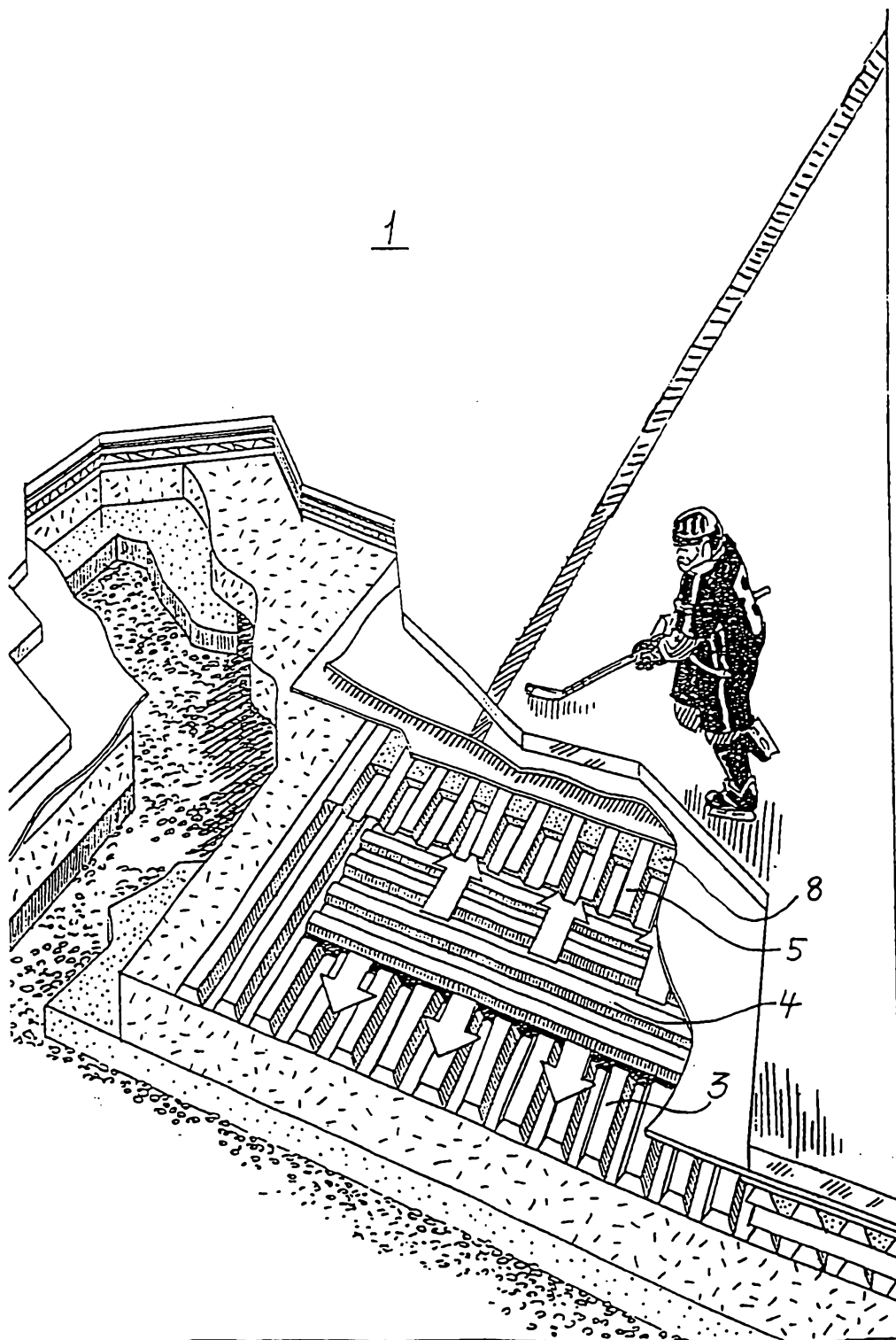


FIG. 3

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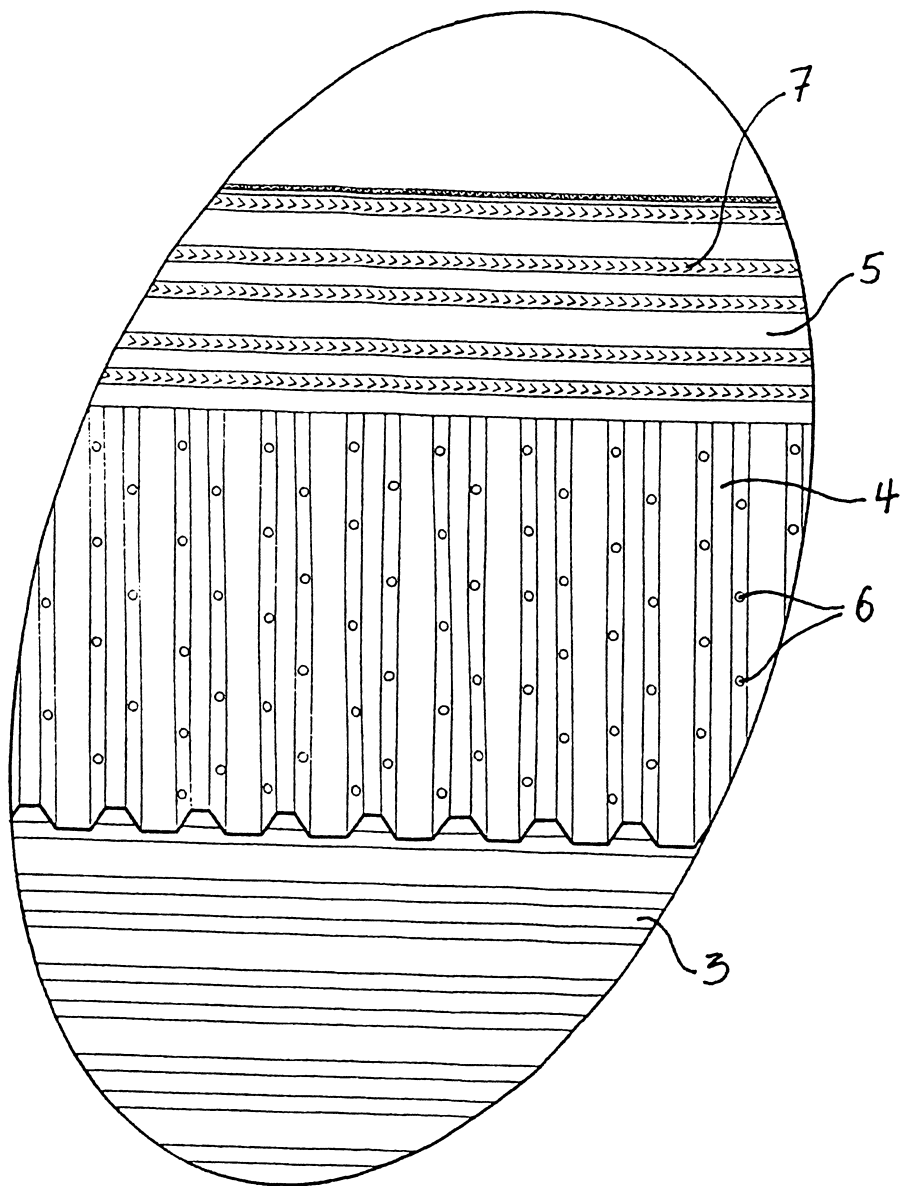


FIG. 4

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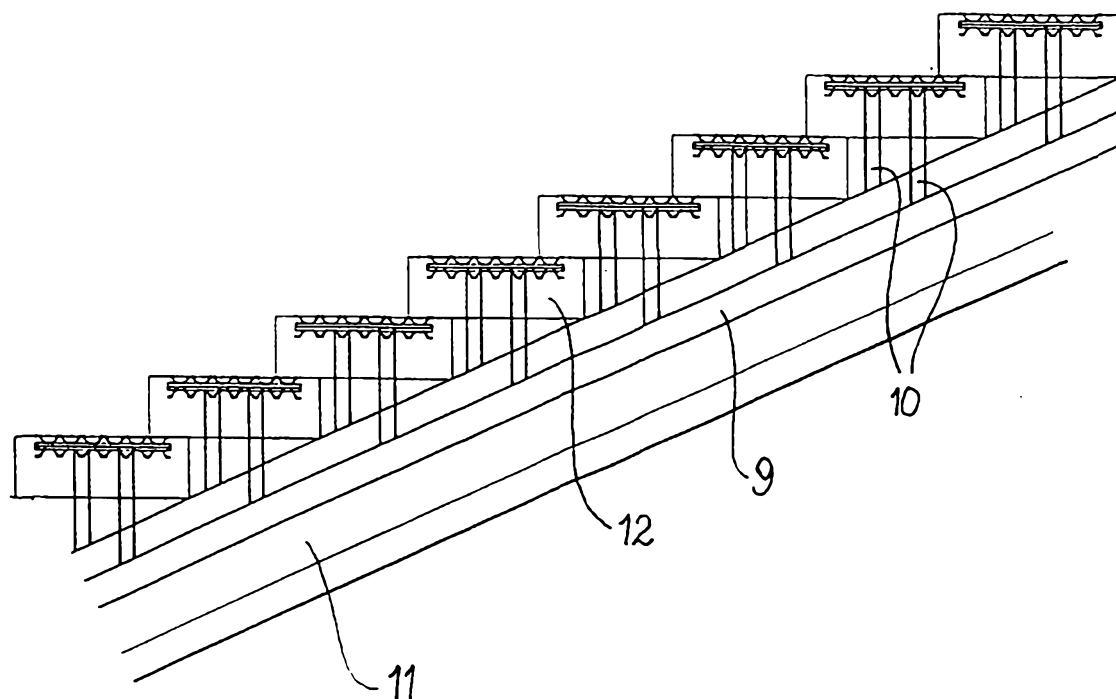


FIG. 5

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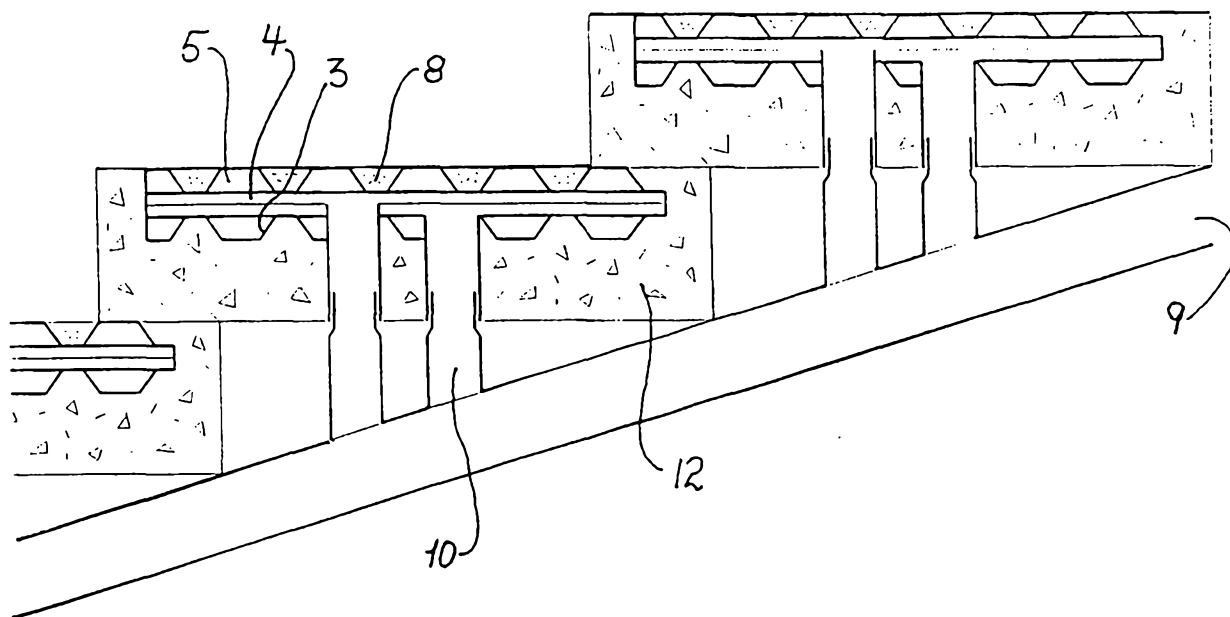


FIG.6

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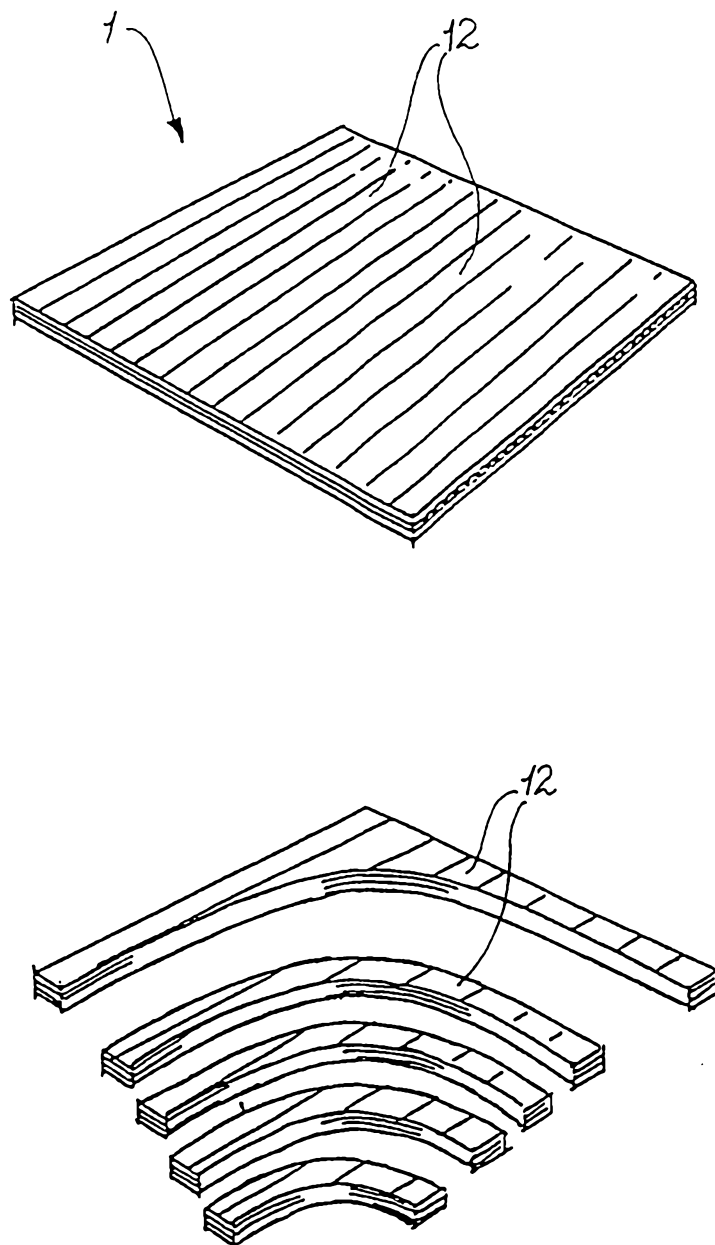


FIG. 7

