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(54) Sports stadium, more particularly ice stadium.

(57) Sports stadium, the sporting area of which is suitable as a base (1) for a standard 400 m artificial ice rink and is surrounded by a strip of ground (3) destinated for the accomodation of spectators and other purposes and the width of which is at least as large as that of a standard 400 m artificial ice rink. It is characterized by a roof (4) covering the base (1) for the 400 m artificial ice rink as an annularly extending lean-to roof, the outer circumferential edge coinciding with a face roll surrounding said strip of ground (3) around said base (1) and the inner circumferential edge overlapping that of a standard 400 m rink on said base (1) (radially) inwardly through an amount the order of which corresponds with the width of such a rink, the height of the roof (4) being selected in the range between 1 and 1,5 times that width, while the upper portion of the face wall (2) adjoining the roof (4) is made uniformly perviously to air along the entire circumference.

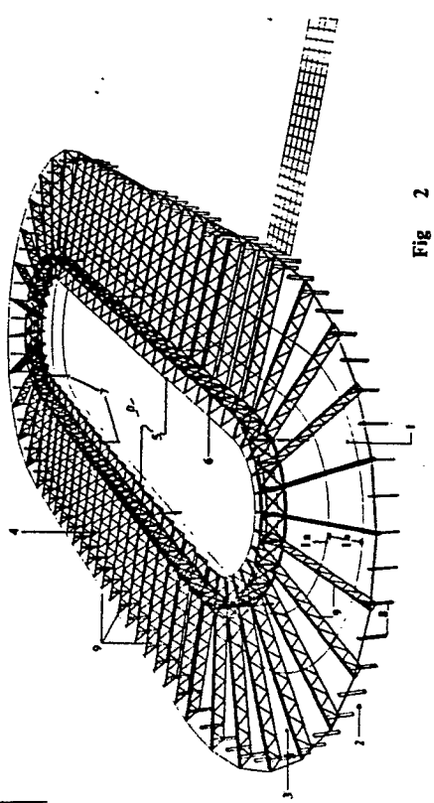

Fig 2

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Sports stadium, more particularly ice stadium.

The invention relates to a sports stadium, the sporting area of which is suitable as a base for a standard 400 m artificial ice rink and is surrounded by a strip of ground destinated for the accommodation of spectators and other purposes and the width of which is at least as large as that of a standard 400 m artificial ice rink.

According to the rules of the International Skating Union (I.S.U.) by "standard 400 m artificial ice rink" an oval-shaped annular rink having a width of 8 to 10 m is meant, the opposite "long sides" of the oval being formed by straight sections having a length between 100 and 115 m, whereas the short sides of the oval are each semi-circularly shaped and have an outer radius which may vary between 32 and 36 m.

These standard dimensions imply that a sporting area is involved, the (largest) length, viz. that according to the longitudinal axis of the standard 400 m rink, is about 180 m and the width of which is about 70 m.

Sports stadia of this type, which are directed to a standard 400 m artificial ice rink, exist in many countries, in particular in those countries, such as the Netherlands, where the (temperature) conditions during winter time are too inconstant and uncertain for having an ice rink, according to a predetermined time schedule, come into existence and then keep it up in a natural way.

An artificial ice rink is created by cooling the ground area serving as a base for it, until below zero by means of refrigerating pipes laying on it or embedded therein, so that the water sprayed onto it will freeze with certainty, thereby forming a coherent ice plate.

This procedure, however, is connected with considerable cost of energy which may rise to a considerable level in case the artificial ice plate is subjected to the influence of wind and rain, as is the case in the Netherlands during the greater part of each winter season. Moreover rain is forming a climate factor which is incompatible with the traditional caracter of a winter sport like (speed) skating. Increasingly wind is also considered by skaters as a factor which spoils the pleasure in skating.

Recently - for the first time a couple of years ago - an ice stadium adapted for maintaining a standard 400 m artificial ice rink, has been roofed in in order to exclude the influence of rain and wind. It is to be noted, however, that the covering of so-called ice hockey rinks, comprising an ice surface of 60 x 30 m, has been known for many decades.

The experiences gained so far with covered 400 m rinks correspond with those obtained with the much smaller covered ice hockey rinks. In a 400 m artificial ice hall without air conditioning the (at least) 4000 m^2 covering ice surface will create in the enclosed space thereabove a climate which is generally felt as chilly and thus unpleasant in connection with the low temperature and the high relative moisture content. By excluding the disadvantageous influence of rain and wind, however, the cost of energy has been substantially reduced as compared with the former situation.

The experiences obtained in a covered 400 m artificial ice rink provided with air conditioning are excellent with respect to the agreeable climate within the hall and also with respect to the quality of the sporting performances accomplished. In this case, however, the cost of energy has - due to the air conditioning equipment - been considerably increased as compared with the former uncovered situation.

A disadvantage of both forms - i.e. with as well as without air conditioning - is that being cut off from the open air is felt as an unreal situation for (speed) skating.

The present invention aims at solving the rain-wind problem of a 400 m artificial ice rink in a manner which combines the advantages of the two well-known solutions discussed hereinbefore and avoids the disadvantages of the same.

The solution proposed by the invention is characterized by a roof covering the base for the 400 m artificial ice rink as an annularly extending lean-to roof, having an outer circumferential edge which generally coincides with a face wall surrounding said strip of ground around said base and an inner circumferential edge overlapping that of a standard 400 m rink on said base (radially) inwardly through an amount the order of which corresponds with the width of such a rink, the height of the roof being selected in the range between 1 and 1,5 times that width, while the upper portion of the face wall adjoining the roof is made uniformly pervious to air along the entire circum-ference.

As a result of the air-perviousness of the upper portion of the face wall there will be a permanent ventilating air flow moving from the outside to the inside along the under side of the roof and leaving in the center through the roof opening. Consequently there will be a permanent natural ventilation, so that the climate under the roof, as far as the temperature and the moisture content are concerned, will always correspond to that of the surrounding atmosphere. Rain and wind will, however, in accordance with the aim of the invention, kept beyond the reach of the ice rink section and the strip of ground surrounding the latter. Wind tunnel

tests with laboratory scale models justify the expectation that even under storm conditions the air velocities under roof level will generally not exceed 1 m/sec, which amount is below the standard for "calm weather". Only in case of a heavy gale longitudinally of the rink moderate windy conditions might occur here and there under roof level.

When constructing the stadium this can be taken into account by choosing the position of the rink such that the roof opening will become oriented with its largest dimension transversal with respect to the direction, from which - statistically - the heaviest winds are blowing.

In fact the solution proposed by this invention makes a surprising use of the circumstance, that the roof opening - as a consequence of the elongated form of a standard 400 m artificial ice rink, has a substantial length - width ratio (about 5:1).

A guanrantee that the standard for "calm weather" under the roof will not be exceeded under all possible wind directions, may be achieved, according to a further feature of this invention, by providing a number of suspending, partially pervious screens between the longitudinal axis of the roof opening.

The energy consumption of a partially covered 400 m artificial ice rink according to the invention approximates that of a completely covered rink without air conditioning. The roof opening is assumed to be large enough to create the illusion that one is skating in the open air. This illusion may be amplified yet when, according to a further feature of this invention, an opaque annular cornice is provided adjacent the circumferential edge of the roof opening.

The partial covering of a sports stadium with a lean-to roof extending inwardly from an outer wall, is known per se. With the well-known sports stadia of this type, however, the main purpose of the roof is to keep the stand around the actual sports ground, dry, while there is no question of the typical elongated shape for a standard 400 m artificial ice rink, and no measures have been taken for creating a permanent ventilating air flow moving from the outside inwardly along the circumference of the stadium.

The invention will be hereinafter further explained by way of example when reference to the drawing.

Fig. 1 shows a plan view of a stadium according to the invention, whereby a portion at the left is shown without and a portion at the right is shown with a covering roof;

Fig. 2 shows a perspective view of the stadium according to the invention, without roofing plates;

Fig. 3 shows a diagrammatic cross-section according to the line III-III in Fig. 1;

Fig. 4 shows a vertical cross-sectional view perpendicular to the longitudinal direction of the roof opening and

Fig. 5 is a plan view of the roof opening provided with wind screens suspended therein according to a diamond pattern.

In Fig. 1 at the left side the base 1 for a standard 400 m artificial ice rink, formed of e.g. concrete with refrigerating pipes embedded therein, is shown. This base has an elongated annular form comprising straight sections of e.g. 113,5m long and a width b of 11 m (the inner strip of 3 m serving as a so-called warming up strip and in fact being not included in the standard width).

The base is confined at the ends by an outer semi-circle having a radius of 33 m and an inner semi-circle having a radius of 22 m. The outer boundary of the stadium which is constituted by a face wall is indicated at 2. 3 designates the strip of ground on which e.g. a gang way and a stand are provided. 5 indicates the inner circumference of an annularly extending lean-to roof 4, covering the base 1 and the strip of ground 3 surrounding it.

As may be seen from the drawing the roof 4 is overlapping the inner circumferential edge 1a of the base inwards through a distance c which e.g. is as large as 8 m.

This creates a roof which has an elongated opening O in the center, the width of which is abut 28 m and the (maximum) length of which is about 140 m in the example under consideration.

The roof 4 comprises an inner main beam 6, which is supported on a number, e.g. eight, posts 7 positioned on a certain distance within the inner circumferential edge of the roof 1, and an outer beam 8 comprising e.g. fourty supports and in which the face wall 2 is incorporated. Between these two beams joists 9 are provided, which extend inwardly beyond the main beam 6. The whole is covered by roof plates formed e.g. of aluminum. Preferably a strip area adjoining the opening O, positioned e.g. above the beam 6, is formed as an opaque cornice.

As shown in Fig. 3 and 4 the roof has a slight slope in the order of 5°.

The upper strip x of the face wall 2, 8 is circumferentially uniformly pervious to air. For this purpose the strip x, which may have a height of 2 to 2,5 m, is formed of cloth having a permeability for air of 40 to 60 %. Due to this air-permeable property of the face wall the permanent ventilating air flow mentioned hereinabove, will be created, which leaves the stadium space via the central opening O as through a stack.

At the inner circumferential edge of the roof the roof height is about 10 m. This relatively small height contributes in creating a situation in which the base 2 and the ground strip surrounding it are

kept free from entering of rain, hail and snow. This height also means that the imaginary cylindrical surface between the bottom and the roof edge is of the same order as the surface of the roof opening O. This circumstance promotes a laminar pattern of the air movements within the stadium. Although the elongated shape of the central roof opening O as such already presents a substantial guarantee against unacceptable air velocities within the stadium, it is preferred to provide a number of vertically suspending screens 11 within the opening O, e.g. at intervals of 10 to 12 m. Such screens, which are air-permeable to an extent to 40 to 60 %, may be formed of cloth and may be attached to relatively light-weight support beams extending from longitudinal edge to longitudinal edge of the opening.

Fig. 5 shows a particular form of wind screen. In fact two long screens are provided in a zig-zag fashion between the longitudinal edges of the opening O and mutually spaced such, that the two screens are intersecting each other according to a diamond pattern.

Claims

1. Sports stadium, the sporting area of which is suitable as a base for a standard 400 m artificial ice rink and is surrounded by a strip of ground destined for the accomo-dation of spectators and other purposes and the width of which is at least as large as that of a standard 400 m artificial ice rink, characterized by a roof covering the base for the 400 m artificial ice rink as an annularly extending lean-to roof, having an outer circumferential edge which generally coincides with a face wall surrounding said strip of ground around said base and an inner circumferential edge overlapping that of a standard 400 m rink on said base (radially) inwardly through an amount the order of which corresponds with the width of such a rink, the height of the roof being selected in the range between 1 and 1,5 times that width, while the upper portion of the face wall adjoining the roof is made uniformly pervious to air along the entire circumference.

2. Sports stadium according to claim 1, characterized in that the height of the roof is chosen such that the surface of the opening confined by the inner circumferential edge of the roof is equal or slightly larger than that of the surface of the imaginary cylindrical surface extending from ground level to roof edge level and extending through the inner circumferential edge of the roof, the upper strip of the face wall adjoining the roof being made pervious to air uniformly around the entrie circumference.

3. Stadium according to claims 1-2, characterized in that a number of suspending screens are provided between the longitudinal edges of the roof opening which screens are partially pervious to air.

4. Stadium according to claim 3, characterized in that two or more screens are provided in a zig-zag fashion between the longitudinal edges of the opening at such mutual spacings, that the screens are intersecting each other according to a diamond pattern.

5. Stadium according to claims 3-4, characterized in that the height of the screens corresponds with that of the inwardly extending joists.

6. Stadium according to claims 1-5, characterized in that an opaque strip-shaped cornice is provided adjacent the inner circumferential edge of the roof opening.

7. Stadium according to claims 2 to 6, characterized in that the pervious screens are made of cloth having a permeability of 40 to 60 %.

8. Stadium according to claims 1-7, characterized in that the upper strip of the face wall is formed of cloth having a permeability of 40 to 60 %.

9. Stadium according to claim 8, characterized in that the pervious face wall strip has a height of 2 to 2,5 m.

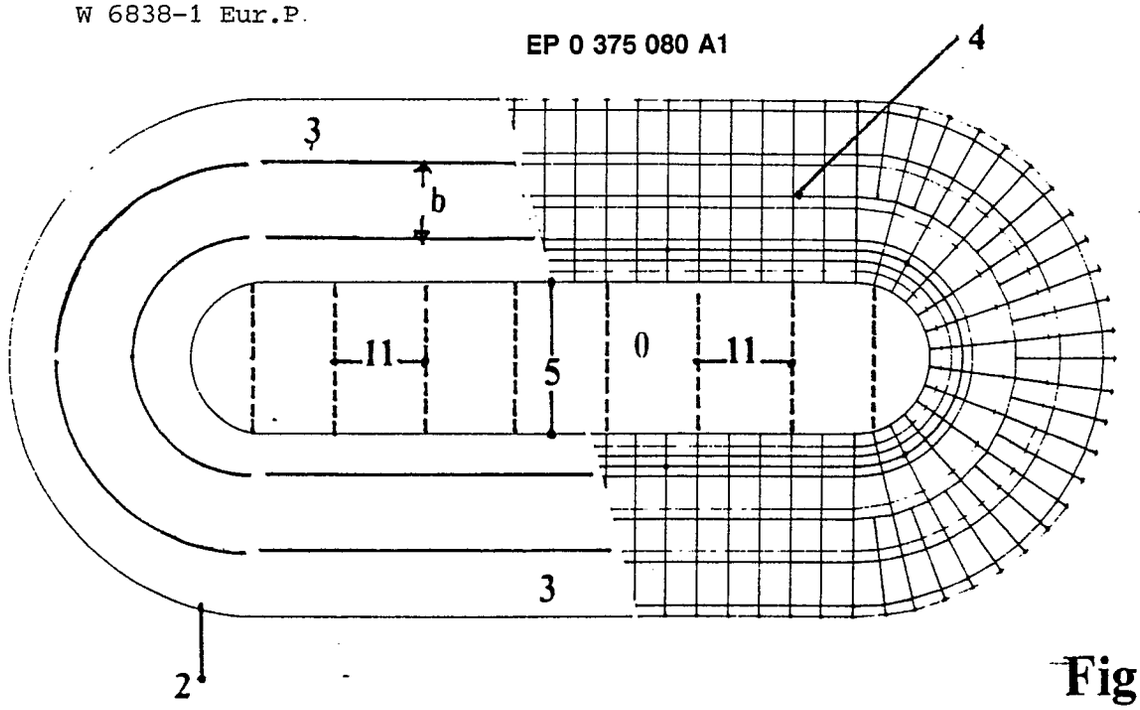

Fig 4

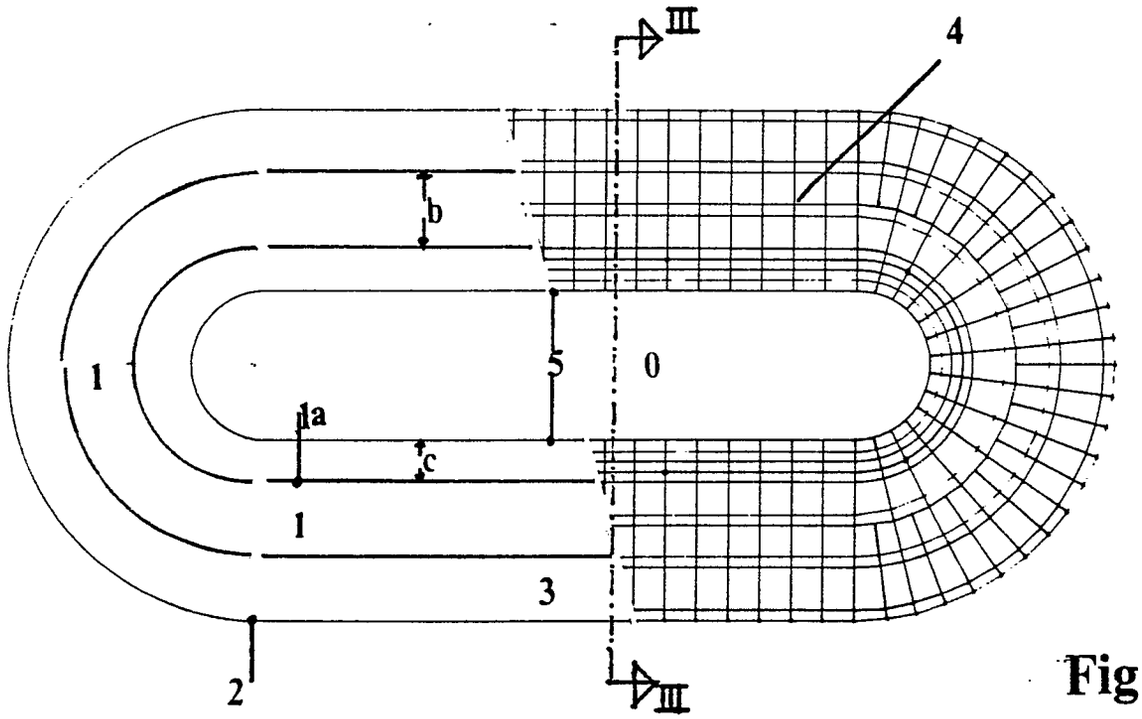

Fig 1

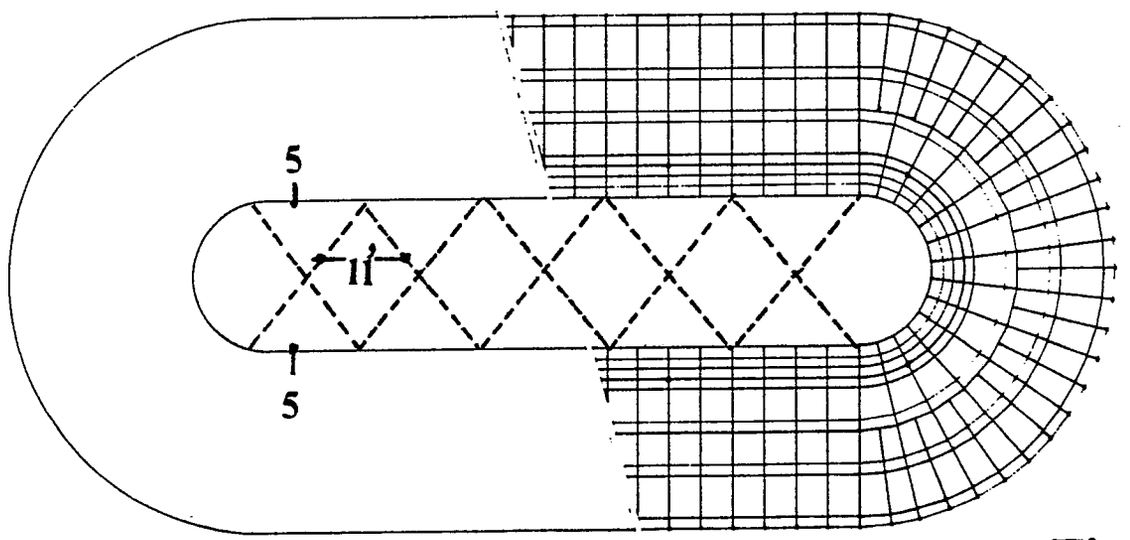

Fig 5

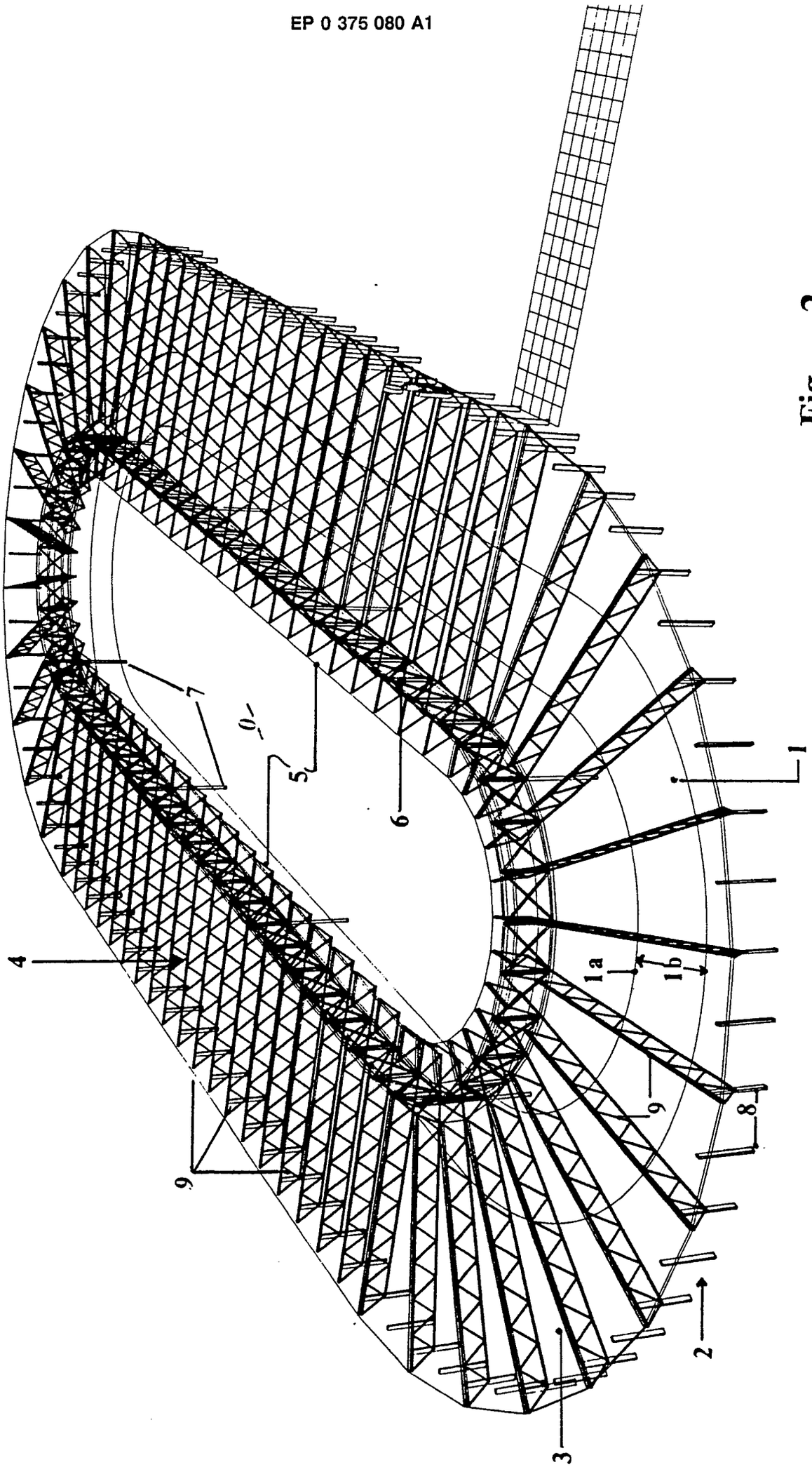

Fig 2

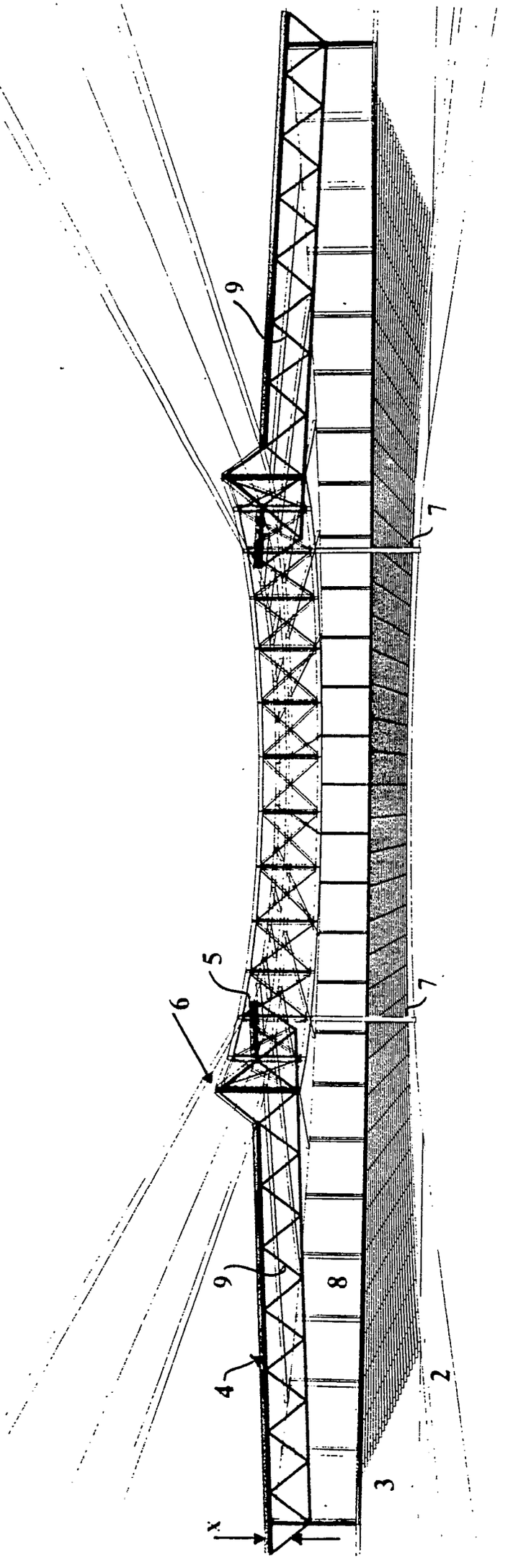

Fig 3

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EUROPEAN SEARCH REPORT

Application Number

EP 89 20 3303

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	FR-A-2 153 032 (STEINGASS) * page 1, lines 1-9; page 4, line 8 - page 5, line 18; drawings * ---	1,2	E 04 H 3/14 E 04 B 1/342
A	US-A-3 619 958 (VIESI) * Column 3, line 17 - column 4, line 10; drawings * ---	1,2	
A	GB-A-1 332 622 (SUMASPACE) * Page 1, line 55 - page 2, line 65; drawings * ---	1,2	
A	ARCHITECTUUR/BOUWEN, vol. 3, no. 2, February 1987, pages 27-32, Rijswijk (ZH), NL; P. GROENENDIJK: "De overdekte kunstijsbaan in Heerenveen" -----		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A 63 C
E 04 B
F 04 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29-03-1990	LAUE F.M.

CATEGORY OF CITED DOCUMENTS

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