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(54) **STEP STONE FOR A STAIRWAY AND A STAIRWAY ASSEMBLED THEREFROM**

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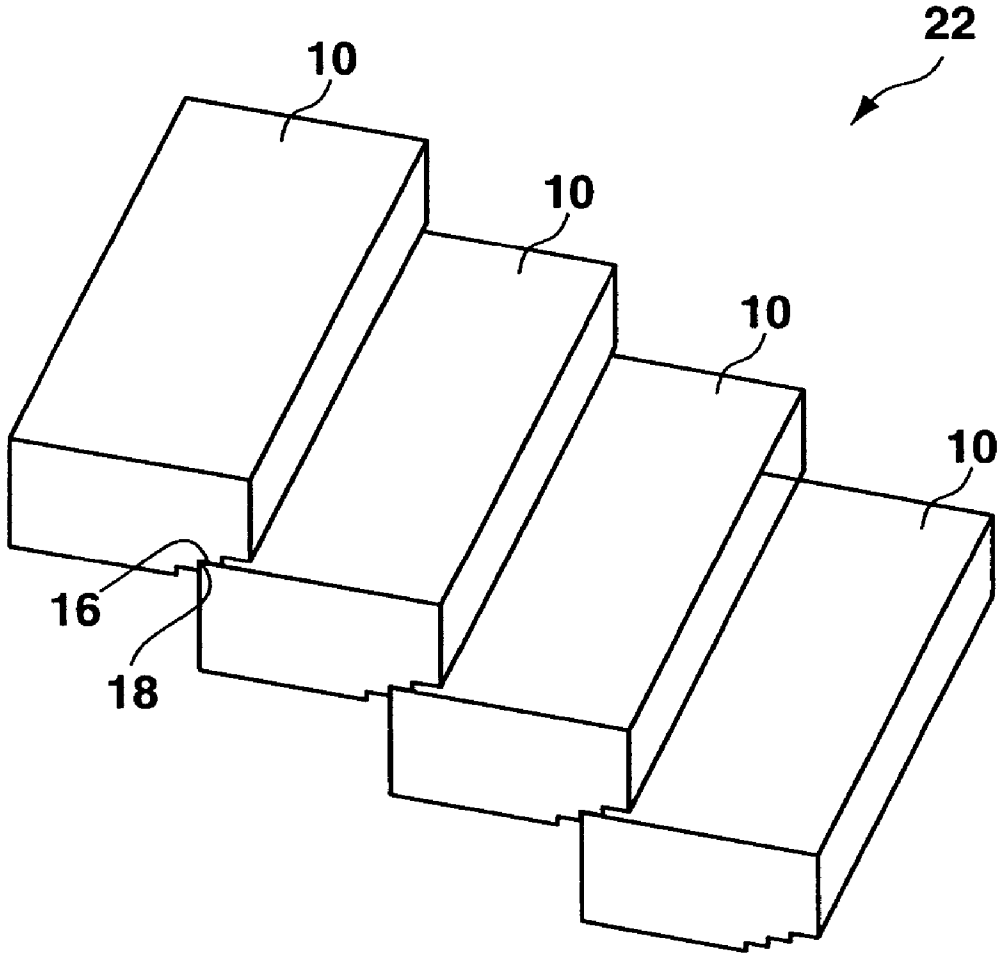
(57) **ABSTRACT**

The invention relates to a step stone for a stairway comprising an upper essentially horizontal stepping surface, a front essentially vertical setting surface, a rear back surface, which is located opposite the setting surface and which, with the stepping surface, forms an upper rear edge, and comprising an underside. A supporting section with a recess is provided in the front area of the underside of the step stone, whereby said recess enables the step stone to be supported on a step stone located directly underneath in order to form a stairway. To this end, the supporting section has a number of stepped recesses, which are offset with respect to one another and with which the step stone can be placed as desired onto the rear edge of the step stone located directly underneath.



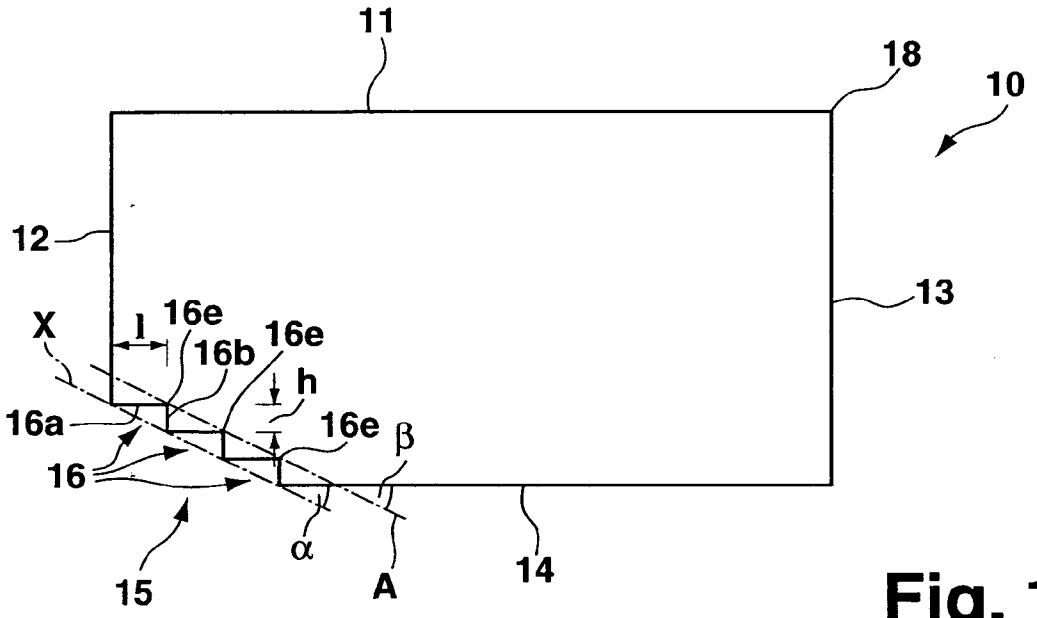

11
18
10
12
13
X
l
16e
16b
16e
h
16a
16e
β
16
15
α
A
14

Fig. 1

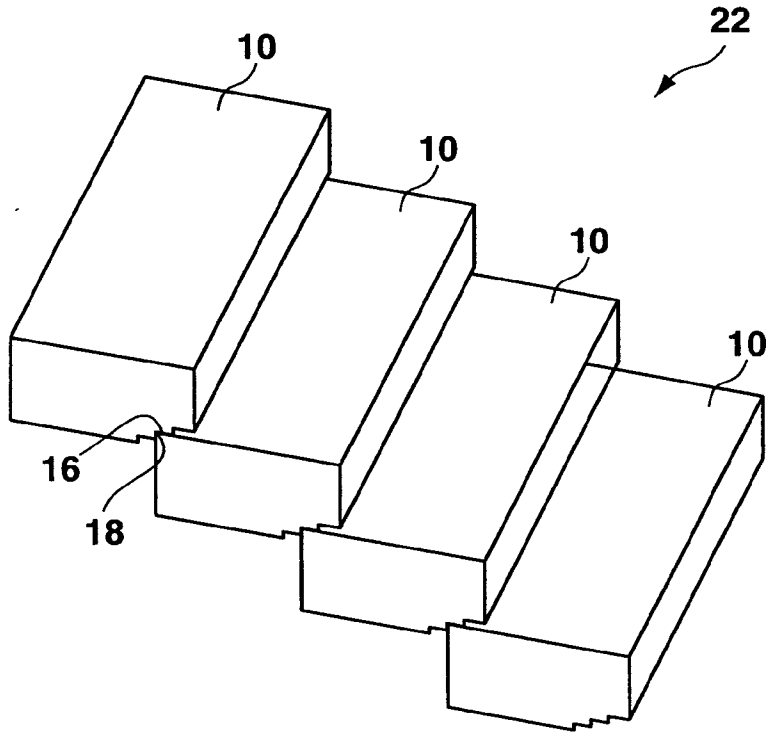

22
10
10
10
10
16
18

Fig. 2

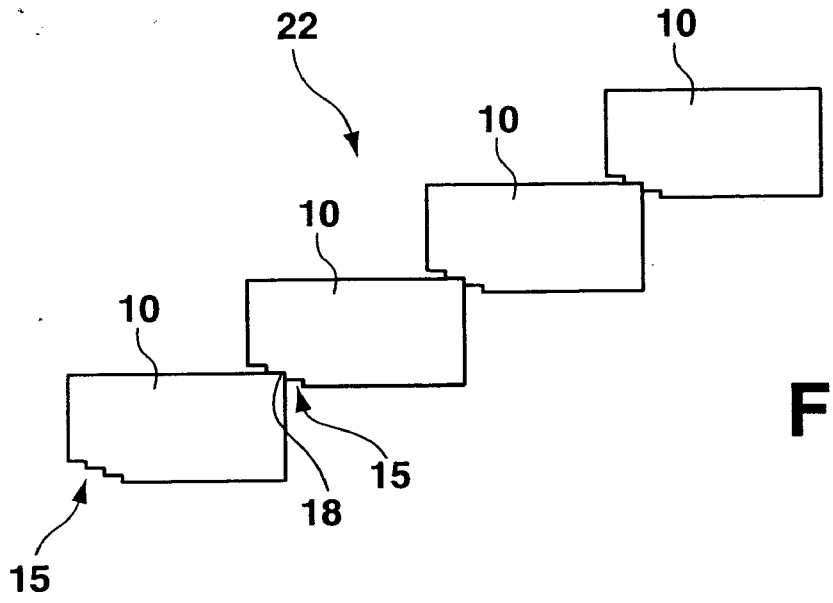


Fig. 3

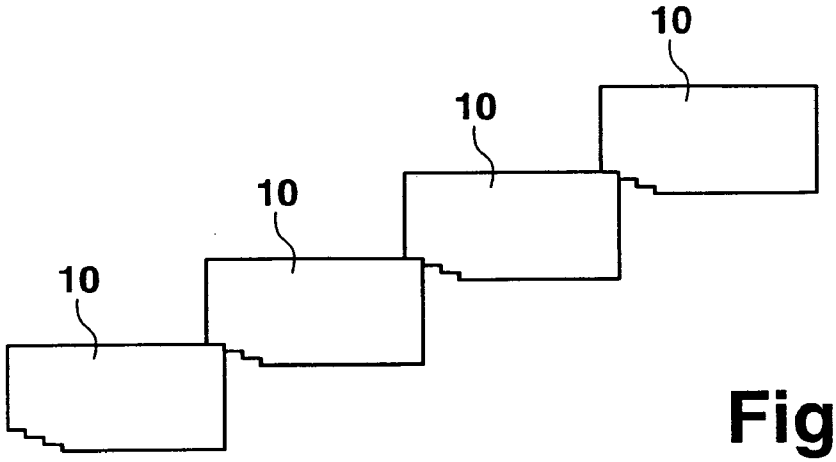


Fig. 4

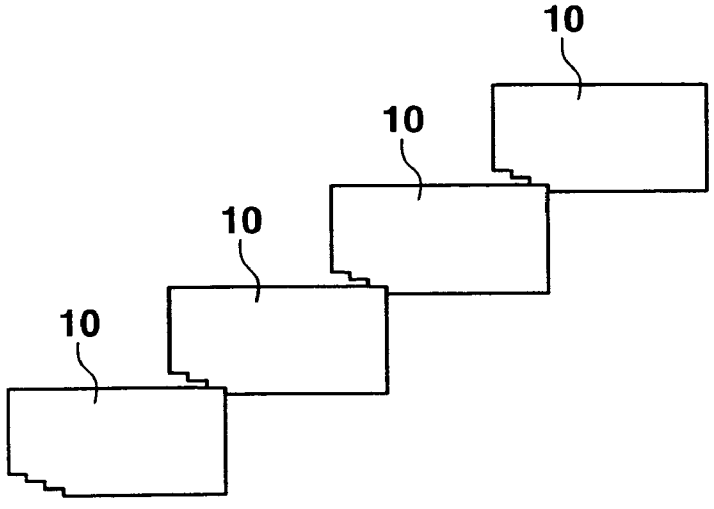


Fig. 5

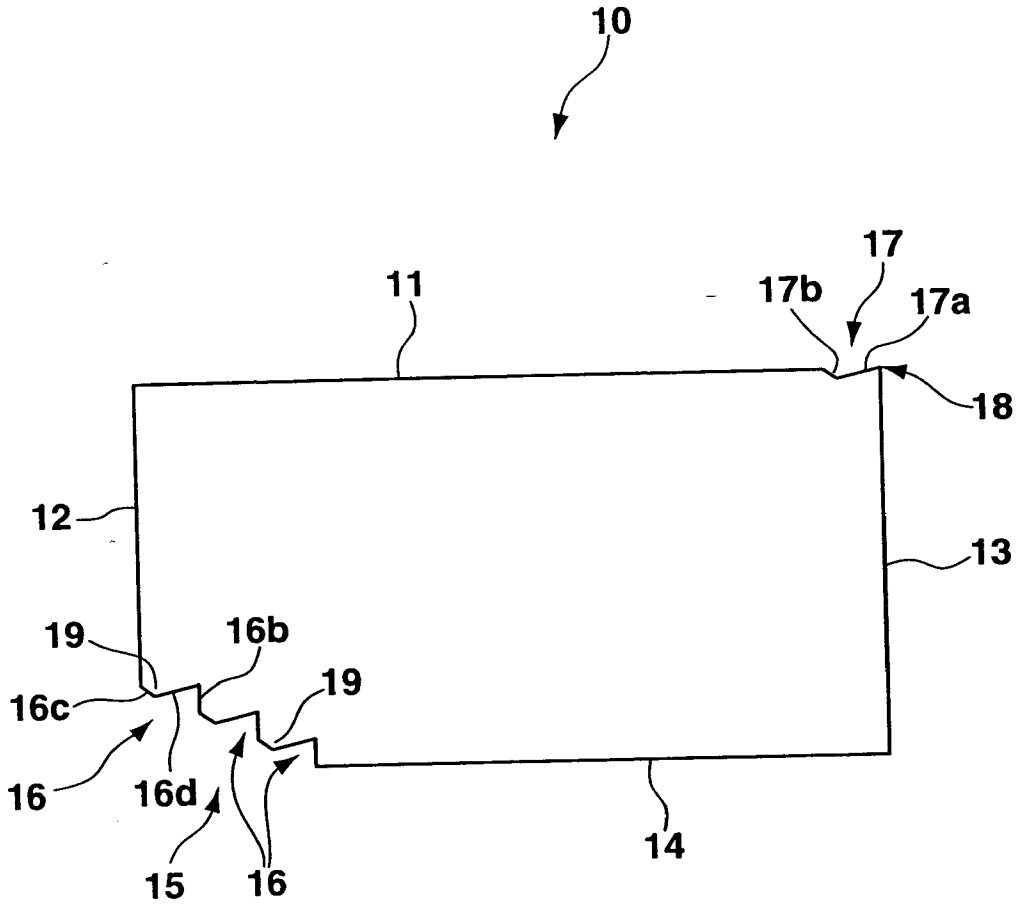


Fig. 6

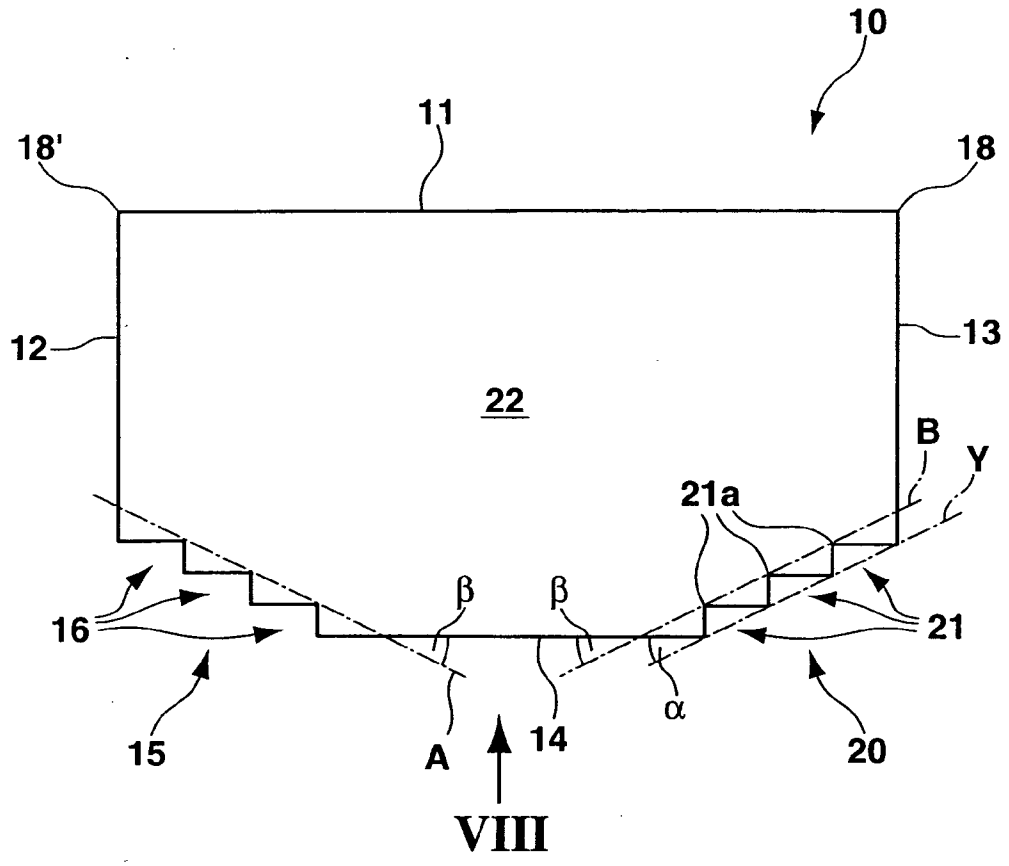

10
11
18'
18
12
13
22
B
Y
21a
β
β
16
21
15
A
14
α
20
VIII

Fig. 7

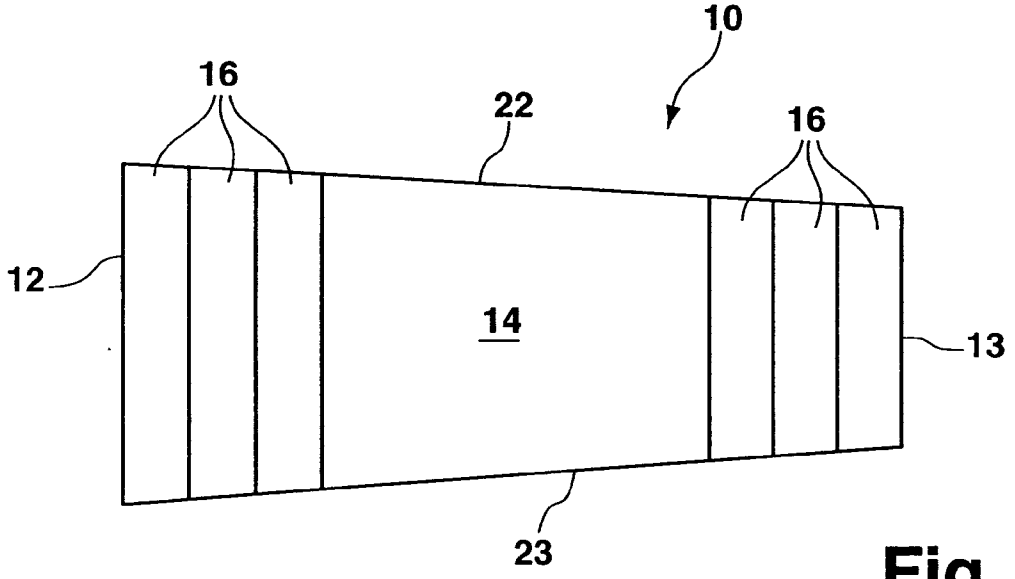

10
16
22
16
12
14
13
23

Fig. 8

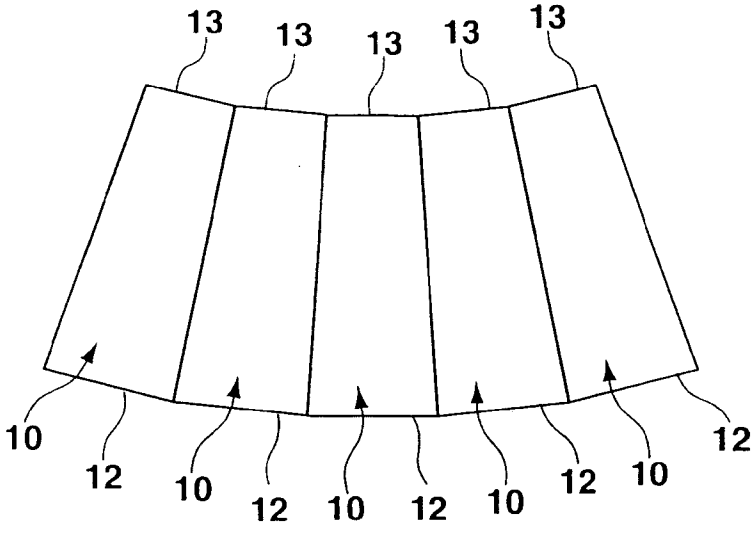


Fig. 9

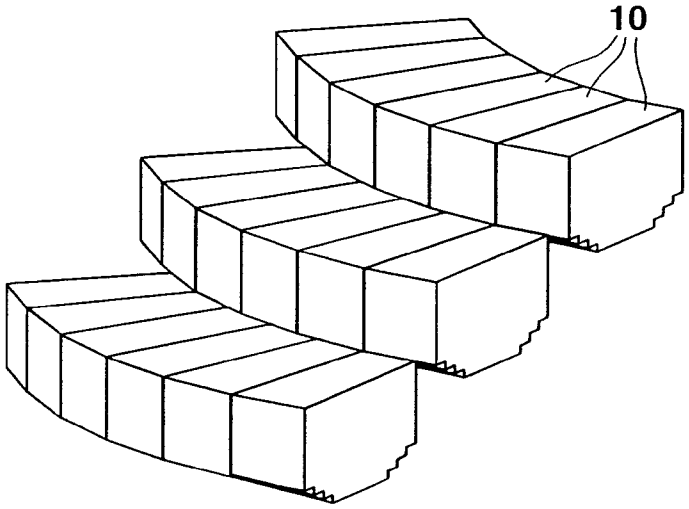


Fig. 10

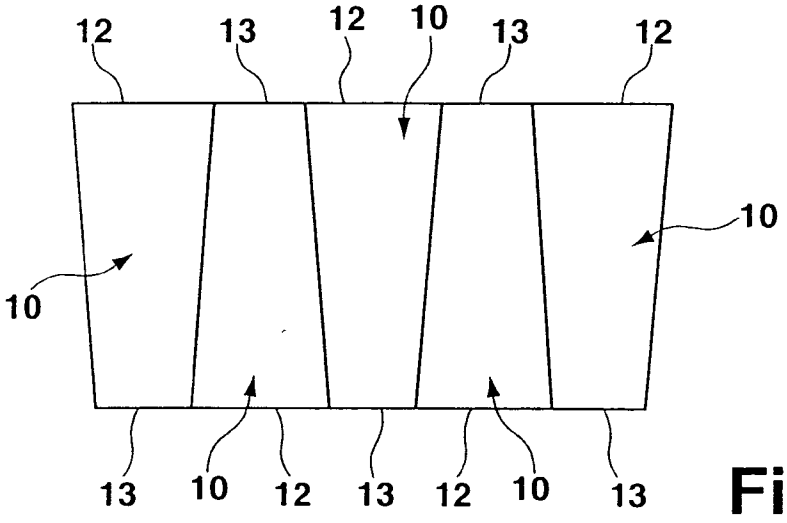


Fig. 11

STEP STONE FOR A STAIRWAY AND A STAIRWAY ASSEMBLED THEREFROM

[0001] The invention concerns a step stone for a stairway comprising an upper substantially horizontal stepping surface, a front substantially vertical setting surface, a rear back surface which is located opposite the setting surface and which, with the stepping surface, forms an upper rear edge, and comprising an underside, wherein a supporting section with a recess is provided in the front area of the underside of the step stone, the recess enabling the step stone to be supported on a step stone located directly underneath in order to form a stairway. The invention also concerns a stairway formed from such step stones.

[0002] A stairway or steps for securing a slope, which are included in the term "stairway" below, has/have been conventionally produced for a long time from superposed step stones or blocks. Each step stone normally has the shape of an elongated cuboid and is made from rock, concrete or wood and is supported with the front end of its underside on the rear end of the upper side of the underlying step stone. The remaining surface of the upper side of the underlying step stone which is not covered by the upper step stone forms the upper substantially horizontal stepping surface of this step. The size of the stepping surface can be adjusted within certain limits through displacement of the upwardly disposed step stone. The front, substantially vertical setting surface and hence the height of the step is fixed and determined by the height of the cuboid such that different step stones must be used for stairways of different step heights.

[0003] To ensure that the stairway is comfortable for use by a person, the stepping size should be approximately 64 cm which results from the sum of two times the step height plus the length of the stepping surface. To fulfil this condition, the stepping surface must have a certain predetermined length, since the step height is defined by the height of the step stone. A stairway having a predetermined slope therefore requires a certain cuboid step stone wherein subsequent adjustment of the stairway course and stairway slope are not possible. To be able to form different stairway shapes, a plurality of different step stones must be produced and stored which is demanding and expensive.

[0004] DD 145 298 discloses forming of a corbel on the underside of a step stone and fashioning a shoulder in the form of a recess in the front region of the underside. In this fashion, the user can dispose the step stone onto an underlying step stone either with the recess or the integral corbel to realize stairways with two different stairway slopes. The step stone in accordance with DD 145 298 permits more variable use than the earlier conventional cuboid step stone but it is suited only for two different stairway slopes. This does provide sufficient coverage for the number of desired stairway slopes required in practice such that the user still has to work with step stones of different sizes.

[0005] DE 296 09 531 discloses a similar step stone. To further increase the range of applications of the step stone, this publication proposes forming, in addition to a recess in the front lower supporting section of the step stone, a further recess on the upper rear edge which is fashioned between the stepping surface and the rear surface of the step stone. In this fashion, three different stairway slopes can be obtained through cooperation of the recesses of superposed step stones. It is relatively difficult for a user to determine optimum abutment of the step stones for a desired stairway slope. Moreover, the upper end of the stairway still has a recess which is visible on the stepping surface of the upper step and must be filled by placement of a last stone. The height of that last stone must be precisely adjusted to the depth of the recess to prevent undesirable unevenness. The requirement for such a special last stone is tedious and impractical.

[0006] It is the underlying purpose of the invention to produce a step stone of the above-mentioned type which can create several different stairway slopes in a simple fashion. Moreover, a stairway shall be produced from corresponding step stones which can be easily adjusted to the existing conditions at the location of use.

[0007] This object is achieved for a step stone in accordance with the invention in that the front lower supporting section has several stepped recesses with which the step stone can be optionally disposed onto the rear edge of the underlying step stone.

[0008] The front supporting section of an upper step stone is supported on the rear edge of the underlying step stone such that the rear edge engages in one of the recesses of the supporting section. Through selection of that recess which is disposed onto the rear edge of the underlying step stone, the user can easily vary the orientation of superposed step stones relative to each other. When the recess, which engages in the rear edge of the underlying step stone, is changed, not only the size of the stepping surface of the underlying step stone changes but also the step height is simultaneously changed due to the stepped arrangement of the recesses. The recesses define predetermined relative positions of the sequential step stones wherein mutual engagement of the rear edge of the underlying step stone with one of the recesses of the step stone disposed thereabove provides high positioning accuracy and guards against inadvertent displacement of the step stones.

[0009] The opening cross-sections of the recesses are preferably disposed in a plane which is upwardly inclined in the direction towards the front setting surface of the step stone and extends at an angle α with respect to the horizontal stepping surface. The base point lines of the recess cross-sections, i.e. those points with the largest separation from the opening cross-sections of the recesses, can be disposed in a common plane which extends at an angle β with respect to the horizontal stepping surface and which is upwardly inclined in the direction towards the front setting surface of the step stone. If the stepping surface of the underlying step stone is reduced in size through engagement in the rear edge of the underlying step stone of a recess of the step stone directly above which is disposed further inside the step height is simultaneously increased.

[0010] The angle α and in particular the angle β are preferably in a range between 20° and 40° and preferably in a range between 25° and 30°. In this fashion, the above-mentioned requirements with respect to the stepping size can be at least approximately maintained. To exactly meet the mentioned condition, the following must be fulfilled:

$$\tan \beta = 0.5, \text{ i.e. } \beta = 26.565°.$$

[0011] Taking into consideration the usual tolerances for stairways built at a building site, one can assume sufficient fulfilment of the requirement if the angle β is between 25° and 28°. The same is true for the angle α.

[0012] To ensure good engagement between the rear edge and the recess, the rear edge of the step stone should have a cross-section which is complementary to the cross-section of each recess such that the rear edge completely fills the recess when it engages therein.

[0013] In a possible embodiment of the invention, each recess is defined by an upper covering surface and a rear stop surface, i.e. has a triangular cross-section. The intersecting edge between the upper covering surface and the rear stop surface thereby forms a base point line i.e. a line in which the base points of the individual cross-sections of the recesses are located. If the rear edge has a rectangular cross-section (i.e. the stepping surface merges into the rear surface of the step stone at right angles), the covering surface of each recess should extend substantially horizontally and the stop surface substantially vertically. To ensure the above-mentioned step dimensions in any position of an upper step stone relative to a lower step stone, i.e. independent of which recess of the upper step stone is disposed onto the rear edge of the underlying step stone, the length l of the covering surface, i.e. its extension in the longitudinal direction of the stairway should preferably be approximately and in particular exactly twice the size of the height of the stop surface.

[0014] A further development of the invention may provide that a depression is formed at the rear end of the stepping surface into which a nose can be inserted which is formed on the covering surface of each recess. Corresponding engagement of the nose of the recess into the depression prevents inadvertent release of the upper step stone from engagement with the underlying step stone since it must initially be slightly lifted so that the nose comes out of engagement with the depression.

[0015] The depression and the nose preferably have complementary cross-sections such that the nose completely fills the depression to stabilize the position of the step stones.

[0016] In a preferred embodiment of the invention the depression and the nose each have inclined sliding surfaces and associated stop surfaces such that an upper step stone automatically slides, due to gravity, along the superposed sliding surfaces up to mutual abutment of the abutment surfaces at a predetermined desired position when its nose is inserted into the depression of the underlying step stone.

[0017] In a further development of the invention a further supporting section is formed in the rear region of the underside of the step stone which has several stepped recesses with the above-mentioned design whose base lines are in one plane which extends at an angle β with respect to the horizontal stepping surface. The opening cross-sections of the recesses can also lie in one plane which extends at an angle α with respect to the horizontal stepping surface. In this fashion, the step stone can be disposed onto an underlying step stone in two different orientations, rotated through 180° about a vertical axis. When the step stone is turned, its rear surface is used as the front setting surface to produce different structural possibilities for the stairway for different setting surface and rear surface designs.

[0018] The step stone is preferably made from concrete and is formed as a prefabricated concrete part. In particular, it has a constant cross-section across its entire width, i.e. transverse to the longitudinal direction of the stairway.

[0019] To obtain a stairway of uniform width, the step stone may have a constant width in its longitudinal direction, i.e. in the longitudinal direction of the stairway such that the width of the front setting surface is identical with the width of the rear back surface. Alternatively, the side walls of the step stone connecting the front setting surface with the rear back surface may not extend parallel to each other such that the width of the step stone varies in its longitudinal direction. In particular, the width of the step stone may be continuously reduced starting from the front setting surface towards the rear back surface thereby providing the step stone with a conicity which permits formation of straight and also of curved stairway steps.

[0020] To form a stairway from the above-mentioned step stones, an upper step stone is supported with one of the recesses of its supporting section on the rear edge of an underlying step stone as has already been described. One step stone may thereby form one step. However, it is also possible to provide several step stones next to each other to form a step. The step stones preferably have engagement elements protruding from their side walls with which they can be brought into engagement with recesses of a neighboring step stone. If the step stones are conically tapered starting from the front setting surface towards the rear back surface and are disposed next to each other with the same conical orientation, the step is angled in the transverse direction of the stairway such that, when several step stones are disposed next to each other, a polygonally curved stairway step is obtained.

[0021] Alternatively, the above-mentioned conical step stones may form a step which is straight in the transverse direction of the stairway through disposing neighboring step stones in alternating conical orientation.

[0022] Further details and features of the invention can be extracted from the following description of embodiments with reference to the enclosed drawing.

[0023] **FIG. 1** shows a cross-section of a step stone in accordance with a first embodiment;

[0024] **FIG. 2** shows a perspective view of a stairway formed from step stones of **FIG. 1**;

[0025] **FIG. 3** shows a side view of the stairway in accordance with **FIG. 2**;

[0026] **FIG. 4** shows a stairway of **FIG. 3** with reduced slope;

[0027] **FIG. 5** shows a stairway of **FIG. 3** with increased slope;

[0028] **FIG. 6** shows a cross-section of a step stone in accordance with a second embodiment;

[0029] **FIG. 7** shows a cross-section of a step stone in accordance with a third embodiment;

[0030] **FIG. 8** shows a bottom view VIII of the step stone of **FIG. 7**;

[0031] **FIG. 9** shows a top view of a polygonally curved stairway step formed from several step stones in accordance with **FIGS. 7 and 8**;

[0032] **FIG. 10** shows a perspective view of a stairway formed from correspondingly curved stairway steps; and

[0033] **FIG. 11** shows a top view of a straight stairway step formed from several step stones in accordance with **FIG. 7**.

[0034] **FIG. 1** shows the cross-section of a step stone **10** which comprises an upper substantially horizontal stepping surface **11** and a front substantially vertical setting surface **12** which joins at a right angle. The stepping surface **11** forms a rectangular upper rear edge **18** together with a rear substantially vertical back surface **13**, which is opposite to the setting surface **12**.

[0035] An underside **14** of the step stone **10** also extends substantially horizontally and merges in its front region into the front setting surface **12** via a supporting section **15** which extends from the underside **14** with an upward inclination towards the setting surface **12**.

[0036] Three recesses **16**, which are disposed in steps one behind the other, are formed in the supporting section **15** and are mutually offset both in the longitudinal direction of the step stone (from the setting surface **12** towards the rear surface **13**) as well as in the vertical direction of the step stone (from the underside **14** towards the stepping surface **11**). Each recess **16** is defined by a horizontal covering surface **16***a* which extends parallel to the stepping surface **11** and a substantially vertical stop surface **16***b* which joins the rear end of the covering surface **16***a*. The intersecting edge between the covering surface **16***a* and the stop surface **16***b* defines a base point line **16***e* for the respective recess **16**. The base point lines **16***e* of all recesses **16** extend perpendicular to the plane of the drawing and are in a common plane A which extends at an angle β of approximately 26.5° with respect to the horizontal and which is upwardly inclined towards the front setting surface **12** of the step stone **10**. The length l of the covering surface **16***a*, i.e. its extension in the longitudinal direction of the stairway, is twice the size of the height h of the stop surface **16***b*.

[0037] An opening cross-section of each recess **16** extends from the front edge of the covering surface **16***a*, which faces the setting surface **12**, to the lower edge of the stop surface **16***b* facing the underside **14**. The recesses **16** are disposed such that their opening cross-sections are in a common plane X which extends parallel to the plane A and is therefore also inclined at an angle α of approximately 26.5° with respect to the horizontal and slants upwardly towards the front setting surface **12** of the step stone.

[0038] To build a stairway **22** as shown in **FIG. 2**, several step stones are disposed one on top of the other, wherein one recess **16** of each step stone **10** is disposed onto the rear edge **18** of the respectively underlying step stone and is brought into engagement therewith. In accordance with **FIG. 2**, the respective central recesses **16** are disposed onto the rear edge **18** of the underlying step stone. Selection of another recess produces a change of the stairway slope as shown in **FIGS. 3 through 5**.

[0039] **FIG. 3** shows a side view of the stairway **22** in accordance with **FIG. 2**. The central recess **16** is thereby disposed onto the rear edge **18** of the underlying step stone. To form a stairway with a smaller slope (**FIG. 4**) the front recess **16** can engage with the rear edge **18** of the respectively underlying step stone. In this fashion, each respective upper step stone is set back relative to the underlying step stone thereby enlarging the stepping surface **11** of the underlying step stone. At the same time, the step height of the upper step stone is reduced through the offset in height of the recesses **16** due to the angle β of the plane A and the angle α of the plane X such that, in total, the above-mentioned condition with regard to the stepping size is maintained.

[0040] Alternatively, the slope of the stairway can be increased by disposing the respectively upper step stone onto the rear edge of the underlying step stone (**FIG. 5**) at a further inwardly located recess **16**. In this case, the length of the stepping surface is reduced and the respectively upper step stones are simultaneously lifted relative to the respectively underlying step stone such that the step height is increased with the condition for the stepping size also being maintained in this case.

[0041] The step stone shown in **FIGS. 1 through 5** has three recesses. More recesses, in particular four or five, may be provided to increase the range of applications of the step stone. At least three recesses should preferably be present.

[0042] **FIG. 6** shows a cross-section of a step stone **10** in accordance with a second embodiment which only differs from the cross-section of **FIG. 1** in that the rear end of the stepping surface **11** has a depression **17** which is defined by a sliding surface **17***a* extending at a downward angle from the rear edge **18** and a support surface **17***b* adjacent to the front end of the sliding surface **17***a* and being upwardly inclined. One nose **19** is formed on each of the covering surfaces of the recesses **16**, the nose **19** having a complementary cross-section which comprises a downwardly inclined support surface **16***c* extending from the front setting surface **12**, which is parallel to the support surface **17***b* of the depression **17**, and an adjacent upwardly inclined sliding surface **16***d* which extends parallel to the sliding surface **17***a* of the depression **17**.

[0043] When one of the recesses **16** of the step stone is disposed on the rear edge **18** of an underlying step stone, the nose **19** engages completely into the depression **17** of the underlying step stone thereby obtaining exact orientation of the step stones, disposed one on top of the other. If the nose of the upper step stone is not completely inserted into the depression of the underlying step stone, the inclined sliding surfaces **17***a* and **16***d* guarantee that the upper step stone slides with its nose **19** into the depression **17**, due to its intrinsic weight, until the support surfaces **17***b* and **16***c* abut at the desired position.

[0044] **FIG. 7** shows a further development of the cross-section of **FIG. 1**. Three recesses **16** are provided in the front supporting section **15** as described in connection with **FIG. 1**. The rear region of the underside **14** of the step stone is also provided with a further supporting section **20** which also has three stepped recesses **21** which are designed to correspond to the recesses **16** such that the front and rear recesses are pairwise disposed at the same level. The base lines **21***a* of the recesses **21** are in a common plane B which extends at an angle β with respect to the horizontal stepping surface **11** and rises in the direction towards the rear surface **13** of the step stone **10**. The opening cross-sections of the recesses **21** are in a common plane Y which extends at an angle α with respect to the horizontal stepping surface **11** and rises from the underside **14** towards the rear surface **13** of the step

stone. The design of the step stone with two supporting sections disposed on different sides, each with several stepped recesses permits use of the step stone **10** in different orientations, rotated through 180° about a vertical axis. The step stone **10** shown in **FIG. 7** may be disposed with a recess **16** of the front supporting section **15** on the rear edge of the underlying step stone, wherein the front setting surface **12** determines the height and design of the step. Alternatively, the step stone can be disposed with one of the recesses **21** of the rear supporting section **20** onto the rear edge of the underlying step stone wherein the rear surface **13** of the step stone becomes the setting surface and determines the design and height of the step. This use of the step stone in different orientations is particularly advantageous when the step stone does not have a constant width i.e. in the direction perpendicular to the plane of the drawing.

[**0045**] **FIG. 8** shows a step stone **10** which is wider in the region of its setting surface **12** than in the region of its rear back surface **13** wherein the width is continuously reduced from the front setting surface **12** to the rear back surface **13** such that two side walls **22** and **23** of the step stone do not extend parallel to each other and the step stone is strongly conically tapered in width towards its rear end. In the embodiment shown, the step stone has an equilateral trapezoidal outline but could also have a non-equilateral trapezoidal profile.

[**0046**] One individual step can be formed from one single step stone. It is also possible to dispose several step stones next to each other for forming a step. If the step stones disposed next to each other conically taper towards their rear end as mentioned above, and are disposed next to each other with the same conical orientation (**FIG. 9**), the front wider setting surfaces **12** border and produce a polygonal curved convex shape for the front side of the step. **FIG. 10** shows a perspective view of a stairway formed with corresponding steps.

[**0047**] The same conical step stones also permit formation of a step which is straight in the transverse direction when neighboring step stones **10** are disposed in an orientation rotated through 180° (with alternating conical orientation). The front surface of a corresponding step is formed alternately by the setting surface **12** of a step stone and the adjacent rear surface **13** of the neighboring step stone.

1. Step stone for a stairway comprising an upper substantially horizontal stepping surface (**11**), a front substantially vertical setting surface (**12**), a rear back surface (**13**) opposite to the setting surface (**12**) which, together with the stepping surface (**11**), forms an upper rear edge (**18**) and with an underside (**14**), wherein a supporting section (**15**) is formed in the front region of the underside (**14**) of the step stone (**10**), the supporting section (**15**) having several stepped mutually displaced recesses (**16**) with which the step stone (**10**) can optionally be disposed onto the rear edge (**18**) of an underlying step stone to construct a stair way, wherein the base point lines (**16***e*) of the cross-sections of the recesses (**16**) are disposed in a plane (A) which extends at an angle β with respect to the horizontal stepping surface (**11**) and which slopes upwardly towards the front setting surface (**12**) of the step stone (**10**), characterized in that the angle β is in a range between 25° and 30°, wherein a further supporting section (**20**) is formed in the rear region of the underside (**14**) of the step stone (**10**) which has several stepped recesses (**21**) whose base point lines (**21***a*) are in one plane (B) extending at an angle β with respect to the horizontal stepping surface (**11**) and rising towards the rear back surface (**13**) of the step stone (**10**).

2. Step stone according to claim 1, characterized in that the angle β is between 25° and 28°.

3. Step stone according to claim 1 or **2**, characterized in that the opening cross-sections of the recesses (**16**) are disposed in a plane (X) extending at an angle α with respect to the horizontal stepping surface (**11**) and sloping upwardly towards the front setting surface (**12**) of the step stone (**10**).

4. Step stone according to claim 3, characterized in that the angle α is between 25° and 28°.

5. Step stone according to any one of the claims **1** through **4**, characterized in that the rear edge (**18**) of the step stone (**10**) has a cross-section which is complementary to the cross-section of each recess (**16**).

6. Step stone according to any one of the claims **1** through **5**, characterized in that each recess (**16**) is defined by an upper covering surface (**16***a*) and a rear stop surface (**16***b*).

7. Step stone according to claim 6, characterized in that the rear edge (**18**) has a rectangular cross-section and the covering surface (**16***a*) of each recess (**16**) extends substantially horizontally with the stop surface (**16***b*) extending substantially vertically.

8. Step stone according to claim 6 or **7**, characterized in that the length l of the covering surface (**16***a*) is substantially twice as large as the height h of the stop surface (**16***b*).

9. Step stone according to any one of the claims **6** through **8**, characterized in that a depression (**17**) is formed at the rear end of the stepping surface (**11**) into which a nose (**19**) formed on the covering surface of each recess (**16**) can be inserted.

10. Step stone according to claim 9, characterized in that the depression (**17**) and the nose (**19**) have complementary cross-sections.

11. Step stone according to claim 9 or **10**, characterized in that the depression (**17**) and the nose (**19**) have inclined sliding surfaces (**16***d*, **17***a*) and associated support surfaces (**16***c*, **17***b*).

12. Step stone according to any one of the claims **1** through **11**, characterized in that it is a prefabricated concrete part.

13. Step stone according to any one of the claims **1** through **12**, characterized in that it has a constant cross-section throughout its entire width.

14. Step stone according to any one of the claims **1** through **13**, characterized in that the side walls (**22**, **23**) connecting the front setting surface (**12**) and the rear back surface (**13**) do not extend parallel to each other.

15. Step stone according to claim 14, characterized in that its width is continuously reduced from the front setting surface (**12**) to the rear back surface (**13**).

16. Step stone according to any one of the claims **1** through **15**, characterized in that its side walls bear projecting engagement elements for engagement into recesses of a neighboring step stone.

17. Stairway of step stones according to any one of the claims **1** through **16**, wherein an upper step stone is supported with one of the recesses (**16**) of its supporting section (**15**) on an underlying step stone and several step stones are disposed next to one another to form one step, characterized in that the step stones taper conically from the front setting

surface **(12)** towards the rear back surface **(13)** and are disposed next to each other with a same conical orientation to form a curved step.

18. Stairway of step stones according to any one of the claims **1** through **16**, wherein an upper step stone is supported with one of the recesses **(16)** of its supporting section **(15)** on an underlying step stone and several step stones are disposed next to one another to form one step, characterized in that the step stones taper conically from the front setting surface **(12)** towards the rear back surface **(13)** and are disposed next to each other with alternating conical orientation to form a straight step.

19. Stairway according to claim 17 or **18**, characterized in that the step stones which are disposed next to each other are mutually engaged via laterally projecting engagement elements.

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