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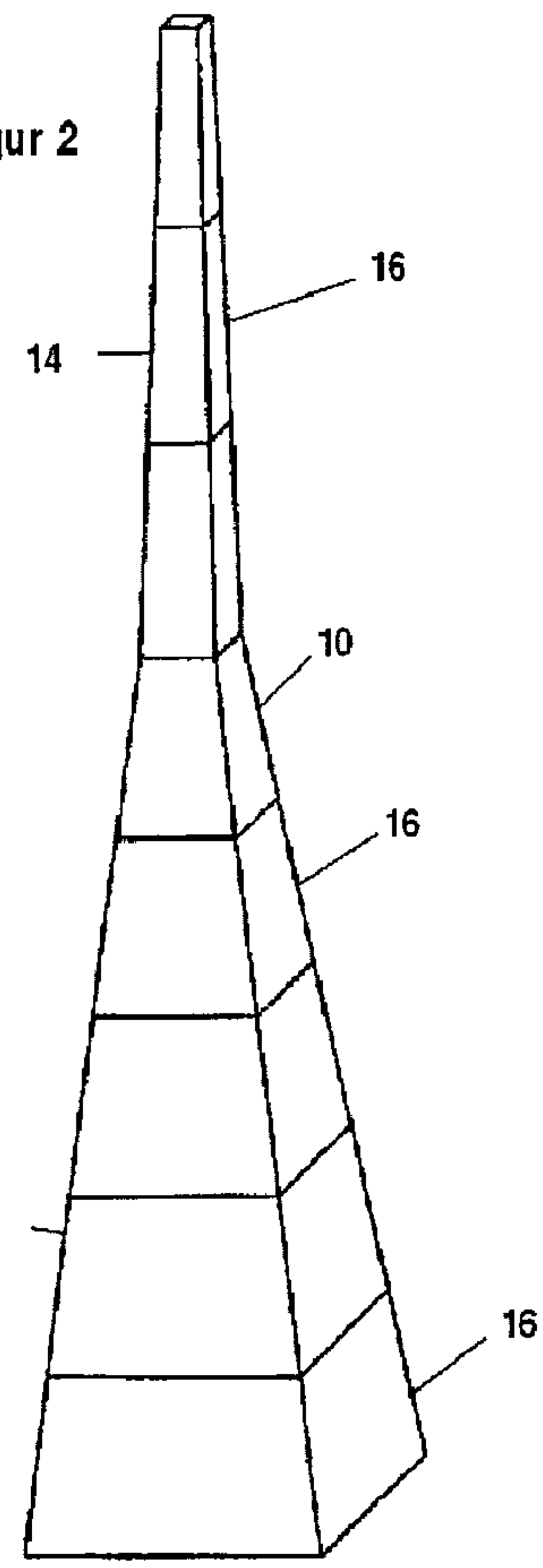
(54) Title: WIND TURBINE

Figur 2



(57) Abrégé/Abstract:
The invention relates to a wind power plant (100) comprising a tower (10). The aim of the invention is to design a wind power plant (100) that is less expensive to produce while maintaining a high degree of efficiency for utilizing wind power, the tower (10) being

(57) Abrégé(suite)/Abstract(continued):
built using simple structural measures. Said aim is achieved by designing the tower (10) as a wooden hollow body, making the tower (10) from modules in the form of segments (16) that are placed on top of each other, and assembling the segments (16) from wood panels (17, 18, 19, 20).

Abstract

The invention relates to a wind turbine (100) with a tower (10). The present invention is based on the task of advancing a wind turbine (100) in such a way that high degrees of efficiency in the use of input wind energy are maintained along with reduced production costs for wind turbines (100) and simple design features in the construction of the tower (10). The task is solved by said tower (10) being a timber-made hollow body, that said tower (10) consists of modules in the form of segments (16), which are arranged on top of each other, and that said segments (16) consist of timber panels (17, 18, 19, 20).

(Fig. 2)

Wind turbine

Technical Field

The invention relates to a wind turbine with a tower.

Prior Art

Wind turbines of the kind mentioned herein above are known and familiar to those skilled in the art.

Atop the wind turbine tower, the machine nacelle is arranged. At the end of the nacelle, a rotor with a horizontally extending pivotal axis is arranged and connected to a generator. It is common practise to use three blade rotors, as they guarantee for a relatively consistent run. Wind turbines of this kind are highly advanced in terms of their efficiency in utilizing input wind energy. Nonetheless, existing wind turbines show significant economic disadvantages. For example, the heavy weight of the rotor and its distance from the tower center which carries the pivot-mounted nacelle results in considerable torque at the tower top. This leads to increased load on the tower along with a consequential increase in construction and manufacturing costs, resulting in high material costs for the tower.

The most common design for wind turbines is based on steel tubing constructions, whereupon the tower load is transferred via a tube or a steel skeleton framing (grid tower) into the ground. In technical terms, such steel tubes are referred to as shell or membrane, and the skeleton framing as linear member. This technical terminology is based on static considerations.

Wind turbine towers vary in height. In general, it may be stated that the energy yield correlates with the height of the wind turbine tower, resulting in heights well above 100 m. Eventually, it can be noticed that not least there is an economic correlation between the construction costs and the yield on energy production, whereby, according to experience, construction costs will rise to disproportionately high levels with increased height of the wind turbine. There have been approaches to construct timber skeleton framings (grid towers) on the grounds that timber is available in sufficient quantities and at reasonable costs. Nonetheless, there are no timber grid towers existing for wind turbines, in as much as the attempt to construct timber skeleton framings for wind turbines uncovered two grave problems. The first one is that the geometry of the tower is predetermined in one aspect: The dimension of the rotor and the physical proximity of the moving rotor blade is limiting the possible dimension of the tower at the virtual contact point.

At this point, the tower construction requires smaller distances between the trusses of the skeleton framing, whereby the diameter that can be chosen for the tower is limited. In expert terminology, this problem is also being referred to as tip/tower or open air problem. The momentum of the load is transferred by large axial forces. In terms of dimensioning, this results in very large and unwieldy and rod cross section radiuses, which are practically not manageable.

Moreover, the skeleton tower of a wind turbine consists of several hundred rods with two to three junctures each. Each of these junctures must be constructed in a way that it can absorb the working load, offering sustainable resistance to the weather conditions at the same time. State of the art technologies allow the production of such junctures. Yet these fasteners are custom-made and require sumptuous production processes, whereas rod connection elements are considered in the first instance.

A significant problem in the construction of timber wind turbine towers is certainly posed by the restricted choices in planning regarding the available geometric options in the rotor area. The external diameter of the tower cannot be easily enlarged. Moreover, as mentioned above the total diameter of the tower depends on the rotor specifications. Given that considerable loads result from the weight of the said rotor, the working loads cannot be easily absorbed by the components of the grid tower.

Description of the invention

Based on the disadvantages detailed herein above, and in consideration of the current state of the art in the area of wind turbines of the kind first above indicated, the present invention is based on the task of advancing a wind turbine of the kind first above indicated in such a way that high degrees of efficiency in the use of input wind energy are maintained along with reduced production costs for wind turbines and simple design features for tower construction.

This task is solved by a wind turbine with the characteristics indicated in claim 1. Advantageous designs and further embodiment of the present intervention are characterized in the subclaims.

According to the invention, the wind turbine tower is a timber-made hollow body.

The advantages of the invention are relative to the construction. The components allow for easy on-site mounting. For example, the components can consist of glued timber panels. The easy on-site mounting of the components, as compared to state of the art constructions, results in logistical advantages. Timber components can generally be produced near the wind turbine location. Moreover, the components are handy, whereby complicated heavy goods transport become avoidable. (It is common to produce and transport state of the art wind turbine towers segment-wise. The segments are huge and require heavy means of transportation).

Another advantage lies in the closed construction of the timber towers. In comparison to shoring constructions, the closed construction of the timber towers protects the necessary fasteners. Insofar, the wind turbine according to the invention will be less exposed to weather conditions.

In addition, timber has a number of advantages over concrete and steel. Concrete and steel are expensive and scarce resources which are only available on the condition of high CO2 emissions. Further, the world market has seen steel prices soaring in the recent past. On the other hand, timber is readily available and comparably easily processed. The creation of value is not bound to a certain location but can be performed by local companies. For state of the art steel towers, however, manufacturing requires highest quality welding which can be performed only by specialist firms.

To respond to static requirements, one advantageous embodiment of the invention includes a tower diameter that expands as it approaches the ground. The segments can be cone-shaped, that is, that the diameter of the towers inclines with increasing proximity to the ground. The cone-shaped segments can be of 20 to 30 m length and be equipped with beads on both ends to allow for immediate on-site mounting. The increasing diameter towards the ground produces more resilient towers. The cone shape reduces material input.

Preferably, the segments of the tower have polygon-shaped diameters. In particular, the polygons can be quadrilateral or pentagonal. The segments can be constructed with assembled and glued timber panels.

Other connection types to interconnect the timber panels are also conceivable.

One practicable variant of the invention provides for glued modules and/or segments. Gluing is a cost-effective and simple connection type for timber parts. Bolting of the modules and/or segments is also conceivable. An alternative way of connecting the segments are beads on both ends that allow for on-site mounting at the wind turbine location.

A different option for connecting segments and/or modules is the connection through plane timber panels which are arranged in between the modules and/or segments, whereas the modules and/or segments can be glued to said panels.

The tower can feature different types of timber. Selection criteria can be hardness and weight of the timbers. Light timber types are spruce, fir, maple, birch, alder, pine, linden tree, walnut, or cherry tree, whereby the single segments may consist of different types of timber. The same applies to the timber panels for the production of the segments if derived timber products are used.

Another advantageous design of the invention provides for the tower being constructed in lightweight mode of construction. The tower is still considered to be the “heaviest part of a wind turbine”, which has an impact on transport costs.

Preferably, the tower is closed at the top and/or the bottom. This may, for example, be achieved by arranging timber panels onto the topmost segment and/or under the lowermost segment of the tower structure and connecting them to these.

Eventually, the invention provides for the application of a tower according to claims 1 to 16 in connection with a wind turbine.

Exemplary designs of the invention are illustrated in the following figures.

Short description of the figures

Showing in a schematic way:

Fig. 1a and 1b — a wind turbine according to the invention in front view and side view;

Fig. 2 — a tower of said wind turbine according to the invention;

Fig. 3a — segments of said tower, which are arranged on top of each other and

Fig. 3b — in exploded view: the construction of one of the said segments of said timber tower according to the invention.

Detailed embodiment of the invention

In Figures 1a and b, a wind turbine according to the invention in front view and side view is illustrated and provided with the reference numeral 100.

The wind turbine 100 consists of a tower 10, with a machine nacelle 13 which is pivotable around a vertical shaft arranged at the free end of the tower, a rotor shaft 12 and a rotor 11 consisting of more than one rotor blades and connected to the rotor shaft 12.

The height of the tower 10 results from the intended hub height of the rotor 11, which again results from the intended diameter of the rotor 11 depending on the designated wind turbine performance. Accordingly, the tower 10 can be of up to 100 m height. The tower 10 is a timber-made hollow body that is formed tapering with increasing height from the base 15 upwards. As can be obtained form figure 1b, the rotor hub is arranged in such a distance from the tower top 14 that a space between rotor blades 11 and the exterior of the tower 10 remains, so that any contact between the rotating rotor blades 11 and tower 10 is impossible.

The embodiment of the tower 10 as illustrated in Fig. 2 consists of a total of 8 segments 16 arranged on top of each other that can, for example, be glued to each other. The segments 16 arranged on top of each other can be of the same length or have differing dimensions as illustrated in the presented embodiment. The presented embodiment shows segments 16 with increasing length towards the top. It is conceivable, however, that the segments 16 are of equal length.

The geometry of the external periphery of the segments 16 can vary. It is conceivable that the external periphery of the segments 16 is designed in circular shape. The presented embodiment includes segments of a preferably quadrilateral polygon diameter. In addition, it can be obtained from figure 2 that the single segments 16 are arranged with their respectively larger diameter underside the subjacent segment 16, e. g. onto the respectively smaller diameter of the respective segment 16 thereunder.

The tower 10 tapers off in a segment 16 which is referred to as tower head in the terminology used herein. At the tower head, the nacelle 13, which is not part of the illustration herein, is situated and can be of lateral and longitudinal dimensions of 5 m x 3 m or of 6 m x 4 m. The timber construction of the tower allows for several tons of total weight of the nacelle 13, the included generator and gearbox and the rotor 11. Dimensions and weights differ for different embodiments. Insofar the indications herein only serve as an example and it is understood that the invention is not limited by them. The tower 10 can be closed by means of timber panels at the top and the bottom.

As can be obtained from figure 3 a, the modules are arranged in the shape of segments 16 on top of each other. The single segments 16 consist of timber panels 17, 18, 19 20, which are connected to each other. The connection type can be glue. The cross sections of the segments 16 increase towards the bottom of the tower, whereby the segments 16 can have different shapes. The embodiment presented herein provides for segments 16 in a polygon shape, whereby the timber panels 17, 18, 19, 20 are of trapezoidal shape. All timber panels 17, 18, 19, 20 of a segment 16 feature identical dimensions, whereby the trapezoidal planes shrink towards the tower top within a segment 16. Thus it is ensured that the tower tapers towards the top, whereby the single segments 16 are directly arranged on top of each other, that is, without an additional part interposed. It is nevertheless conceivable that timber panels are interposed and glued in between the segments 16 to interconnect the segments 16. The segments 16 are arranged precisely fitting on top of each other, that is, that the smallest dimension of one segment 16 is congruent with the largest dimension of the following segment 16.

Figure 3b demonstrates the easy mounting of a segment 16 from timber panels 17, 18, 19, 20. The timber panels 17, 18, 19, 20 can be produced in a previous process directly at a wind turbine location. By gluing the single timber panels 17, 18, 19, 20, which are of trapezoidal shape in the presented embodiment, one segment 16 of the timber tower is created.

Reference list:

100	Wind turbine
10	Tower
11	Rotor
12	Rotor shaft
13	Nacelle
14	Tower top
15	Base area
16	Segments
17	Timber panel
18	Timber panel
19	Timber panel
20	Timber panel

Patent claims

1. Wind turbine (100) with a tower (10), **characterized in that** said tower (10) is a timber-made hollow body, that said tower (10) is composed of modules in the form of segments (16), which are arranged on top of each other, and that said segments (16) are composed of timber panels (17, 18, 19, 20).

2. A wind turbine according to claim 1, **characterized in that** the cross section of said tower ascents towards the bottom.

3. A wind turbine according to claim 1 or 2, **characterized in that** said segments are cone-shaped.

4. A wind turbine according to one of the claims 1 to 3, **characterized in that** said segments (16) provide a polygon cross section, preferably a quadrilateral or pentagonal cross section.

5. A wind turbine according to one of the claims 1 to 4, **characterized in that** said modules or said segments (16) are glued to each other and/or said modules or said segments (16) are interconnected by means of bolts.

6. A wind turbine according to one of the claims 1 to 5, **characterized in that** said timber panels are connected to each other by means of a connection type.

7. A wind turbine according to claim 6, **characterized in that** the connection type is an adhesive.

8. A wind turbine according to one of the claims 1 to 7, **characterized in that** timber panels are arranged in between said modules and/or said segments (16), which provide the connection between said modules and/or said segments (16).

9. A wind turbine according to one of the claims 1 to 8, **characterized in that** said tower (10) consists of different types of timber.

10. A wind turbine according to one of the claims 1 to 9, **characterized in that** said tower (10) is constructed in lightweight mode of construction.

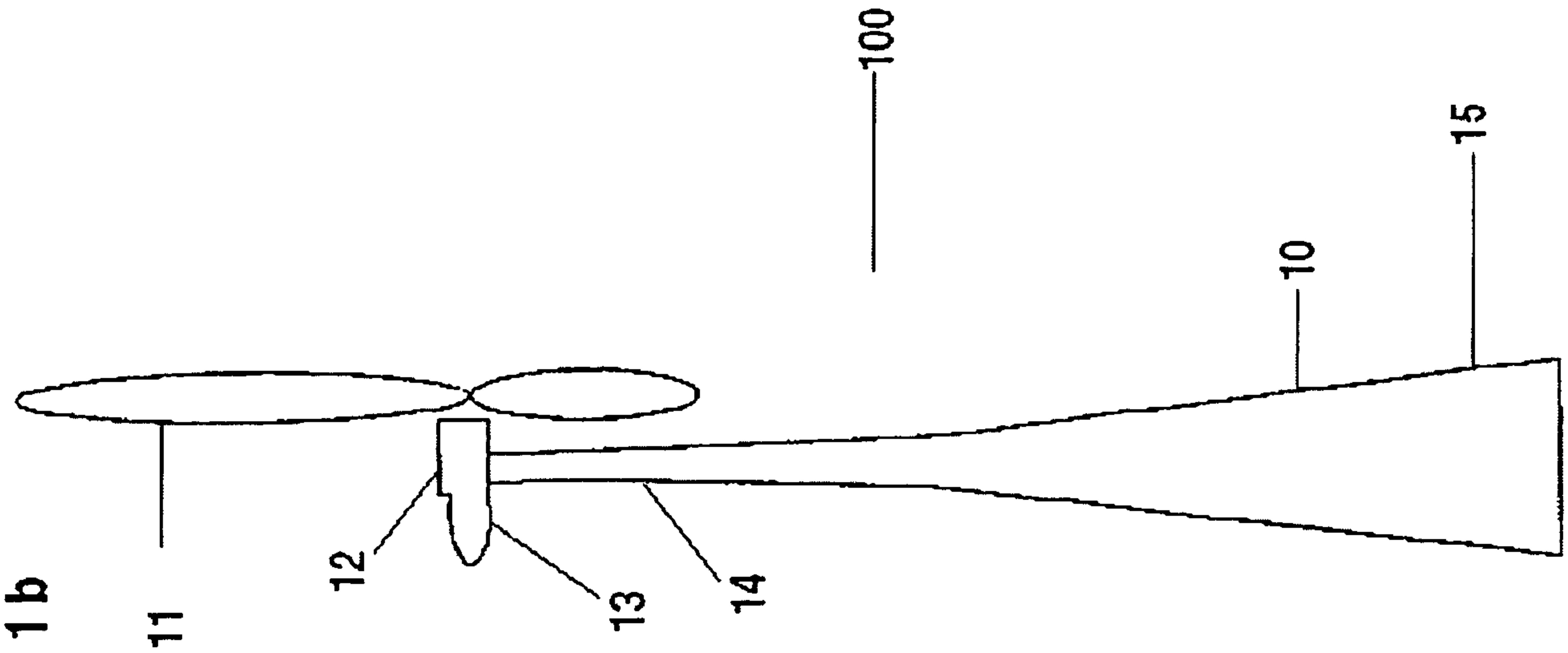
11. A wind turbine according to one of the claims 1 to 10, **characterized in that** said timber panels (17, 18, 19, 20) are of trapezoidal shape.

12. A wind turbine according to one of the claims 1 to 11, **characterized in that** said tower is closed at its top and/or bottom.

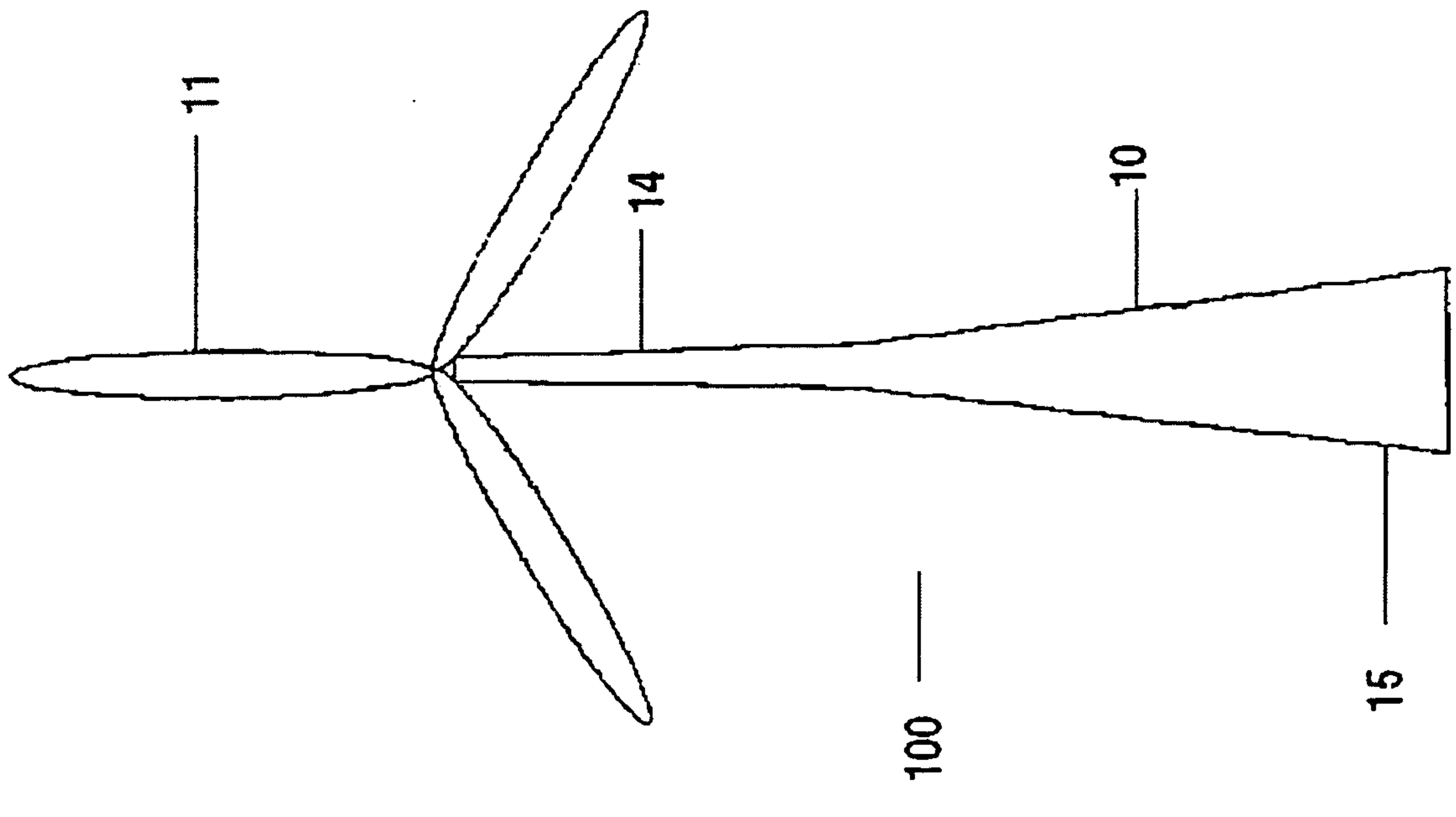
13. A wind turbine according to one of the claims 1 to 12, **characterized in that** said timber panels (17, 18, 19, 20) are made of a derived timber product.

14. A wind turbine according to one of the claims 1 to 13, **characterized in that** the timber panels (17, 18, 19, 20) are made of different types of timber.

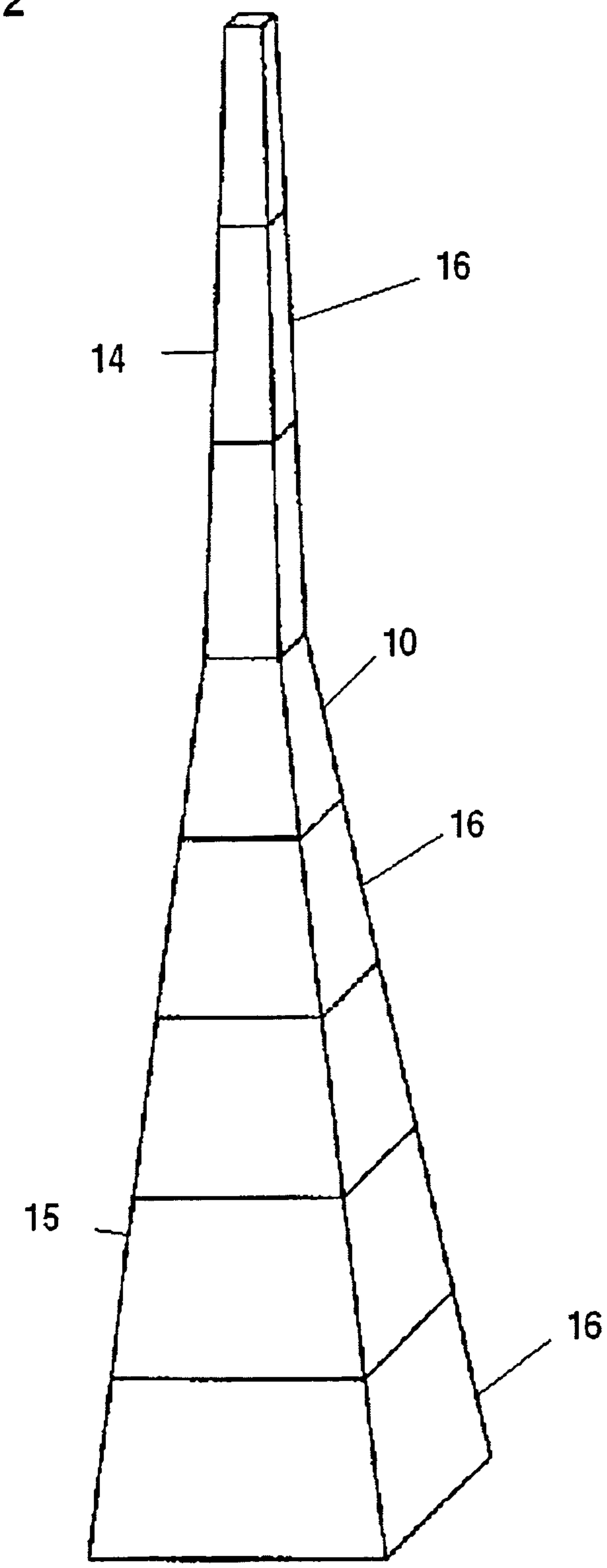
Figur 1 b

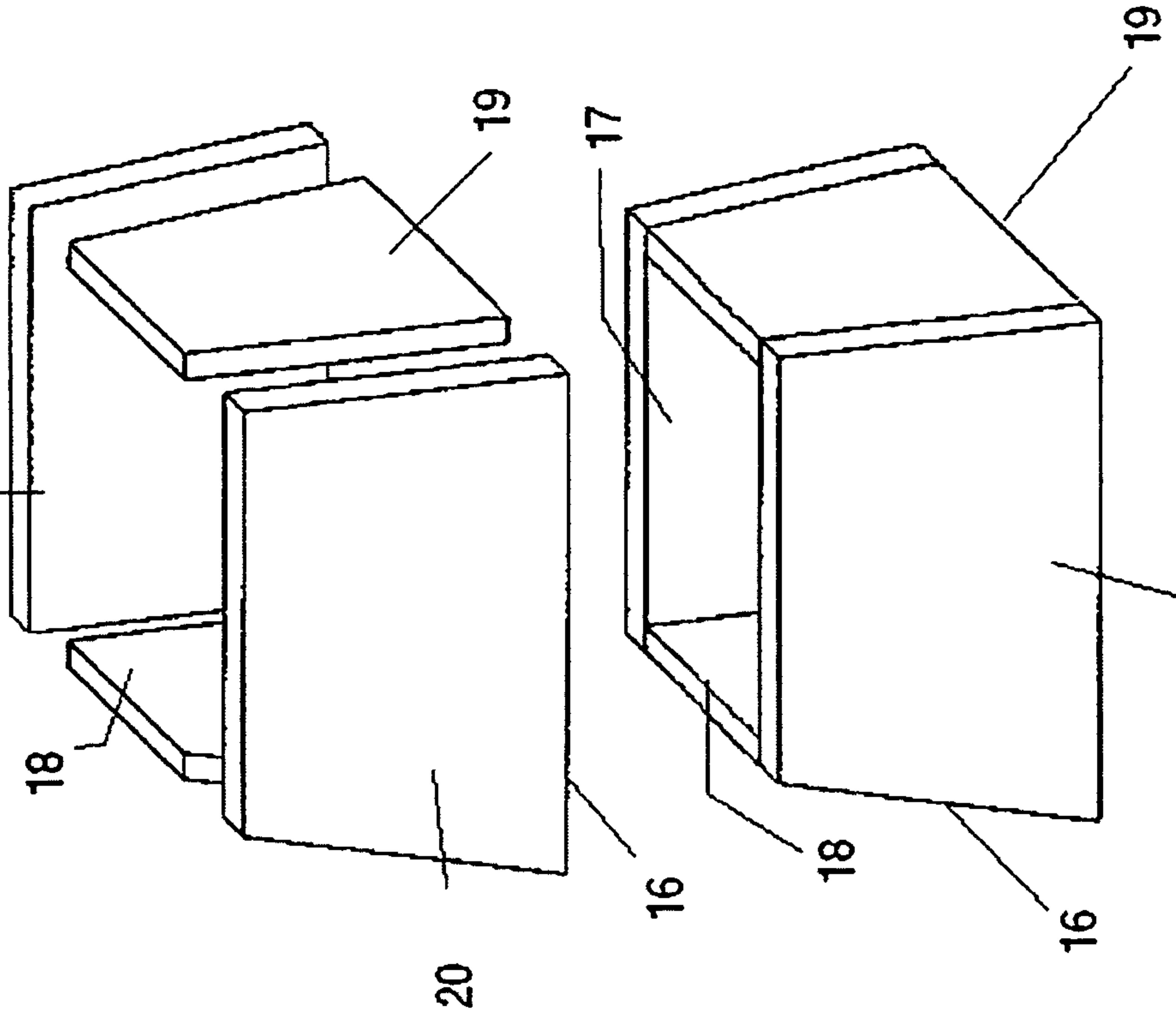


Figur 1 a

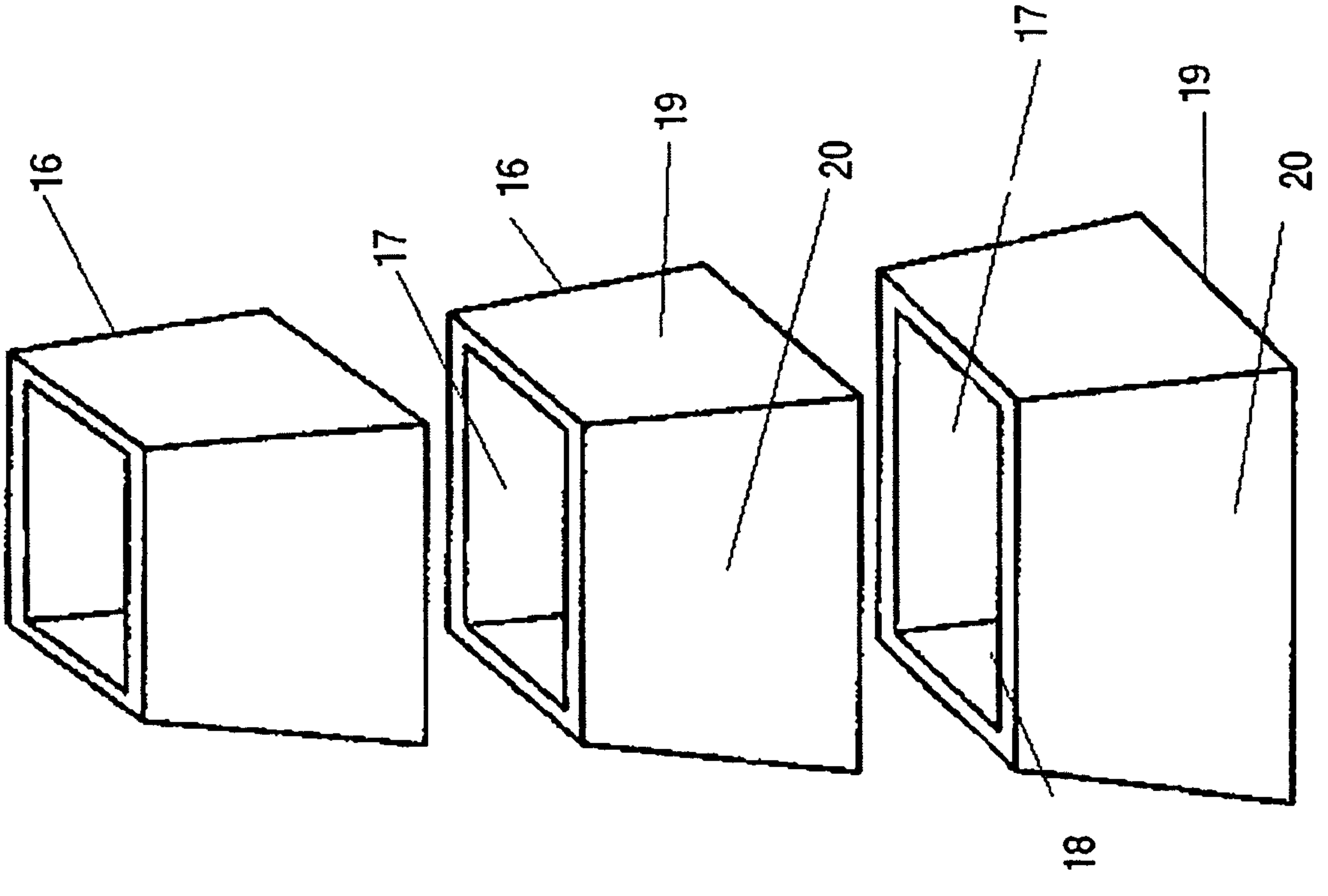


Figur 2





Figur 3 b



Figur 3 a

Figur 2