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(54) Title: PLATFORM, IN PARTICULAR INTERIOR PLATFORM FOR TUBULAR TOWER

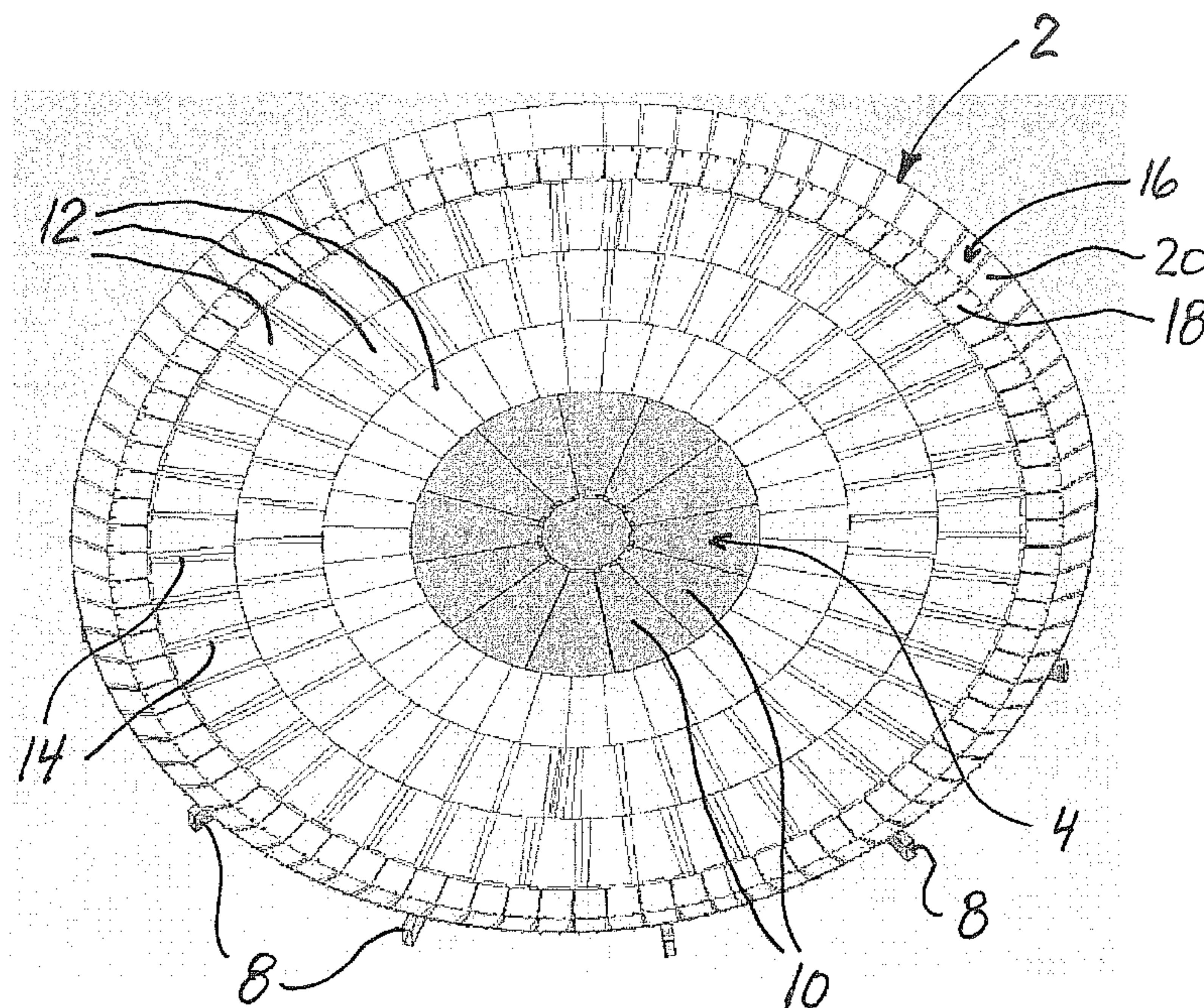


Fig. 2

(57) **Abrégé/Abstract:**

A platform (2) in particular an interior platform for a tubular tower - by way of example a windmill tower (24) made from steel - and more specific a platform (2) adapted to be assembled in situ from a number of construction element members in order to fit the

(57) **Abrégé(suite)/Abstract(continued):**

inside wall (22) of the tower (24), comprising a basic, preferably circular, centre module (4), a number of radial, telescopic supporting beam members (6), and a number of said construction element members in the form of arched modules (10, 12, 14) being independent of the diameter of the platform (2), and a number of two-piece arched modules (16) to be mounted as a periphery ring next to the inside wall (22) of the tower (24).

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(54) Title: PLATFORM, IN PARTICULAR INTERIOR PLATFORM FOR TUBULAR TOWER

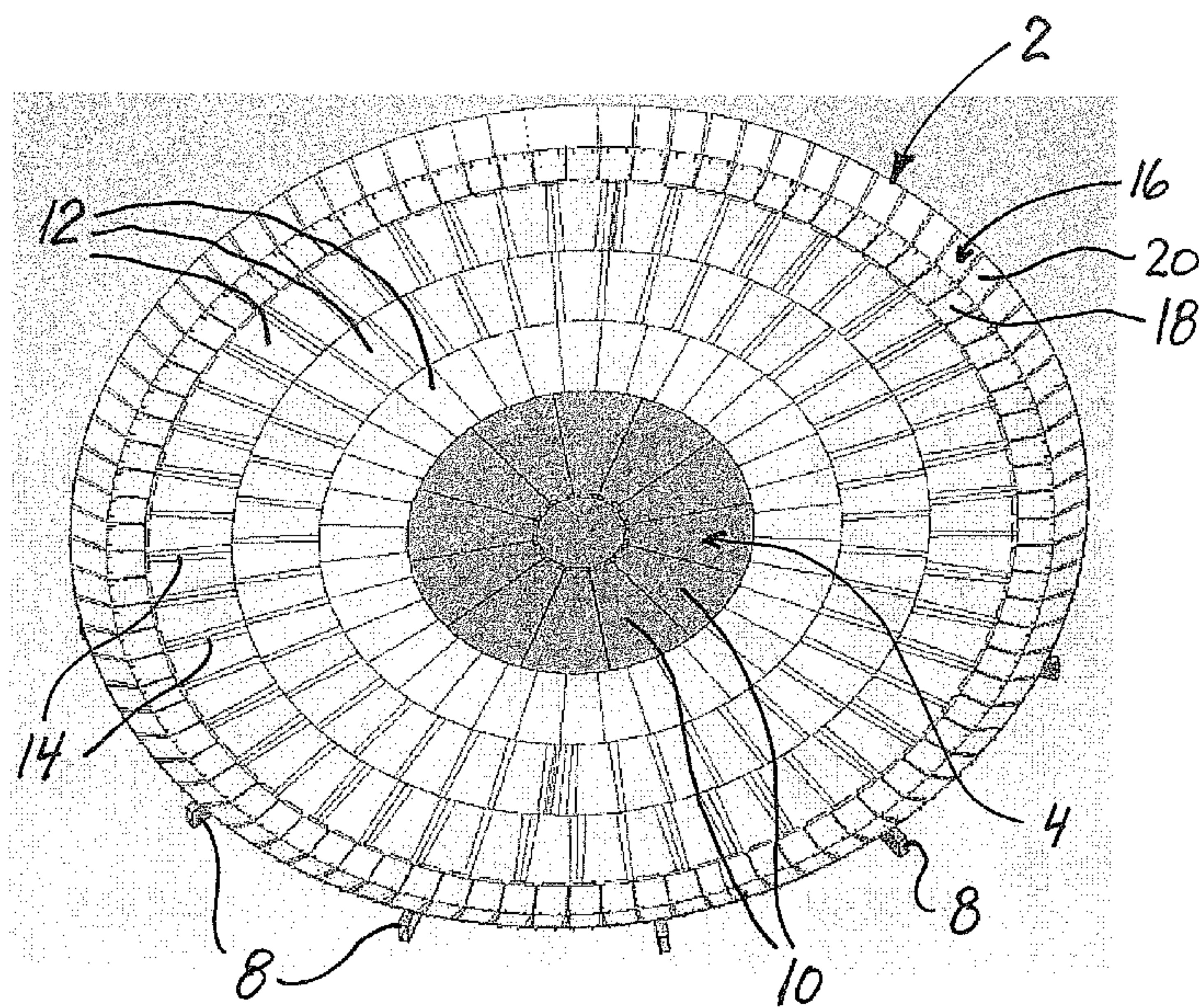


Fig. 2

(57) Abstract: A platform (2) in particular an interior platform for a tubular tower - by way of example a windmill tower (24) made from steel - and more specific a platform (2) adapted to be assembled in situ from a number of construction element members in order to fit the inside wall (22) of the tower (24), comprising a basic, preferably circular, centre module (4), a number of radial, telescopic supporting beam members (6), and a number of said construction element members in the form of arched modules (10, 12, 14) being independent of the diameter of the platform (2), and a number of two-piece arched modules (16) to be mounted as a periphery ring next to the inside wall (22) of the tower (24).

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Platform, in particular interior platform for tubular tower.**Field of the Invention**

The present invention relates to a platform, in particular an interior platform for a tubular tower, by way of example a windmill tower, and of the type indicated in the preamble of claim 1.

5

The invention also relates to a system using an interacting computer program for managing the construction element members of a platform and for controlling the stocks of the necessary construction element members for building a platform of a specific size.

Background of the Invention

10

High towers such as windmill towers are provided with a number of platforms for servicemen and engineers who work inside the tower under the construction period and in connection with the following service operation and maintenance work.

The platform is used for resting when climbing the latter to the top of the tower.

15

Windmill towers have several inside platforms by way of example eight platforms are very often seen.

Additionally the platforms also serve as safety partitions between the different levels inside the tower. These partitions ensure that dropped tools etc only fall a relative short distance - which is widely used especially in the windmill industry.

20

Platforms of the introductory mentioned type are today made from individual made construction element members for each tower in a custom size. The platforms are made from aluminium floor plates that are bended to be self-supporting. Known plates of this type have a width of approximate 500 mm and are bolted together to achieve the desired sizes, as each piece of plate are engineered and manufactured into the specific size and need (Figs. 27 and 28).

25

In other words known methods are expensive because of the engineering and manufacturing costs needed. At the same time there's often problems delivering the aluminium floor plates needed for the manufacturing. Also the logistics is a problem, because the

30

aluminium floor plates are only produced in a few locations in the world. Furthermore the engineering is done only in a few locations. The relatively long manufacturing and delivery time often causes expensive delay of the construction works of the windmill.

5 **Object of the Invention**

The invention has for the purpose to provide an improved platform of the introductory mentioned type and by means of which is achieved a quite new platform concept solving or reducing the need for individual engineering in connection with the assembling of platforms with varying diameters for use as partitions in by way of example inside
10 high windmill towers.

Description of the Invention

The platform according to the invention is characterized in comprising a basic centre module, a number of radial, telescopic supporting beam members, and a number of said construction element members in the form of arched modules being independent of the
15 diameter of the platform.

By simple provisions is hereby achieved a quite new platform concept solving or reducing the need for individual engineering in connection with the assembling of platforms with varying diameters for use as partitions in by way of example inside high windmill
20 towers.

Appropriately the platform according to the invention may be such provided that inner end parts of said radial, telescopic supporting beam members are being rigidly connected with said basic centre module.

25 Furthermore the platform according to the invention may be such provided that outer end parts of said radial, telescopic supporting beam members being adapted to be connected to the inside wall of the tower by means of mounting members by way of example comprising magnets.

30 Preferably the platform according to the invention is such provided that said circular centre module, said construction element members and at least inner parts of said radial supporting beam members are by injection moulding, which moulding material plastic

may possibly be reinforced by means of suitable strength giving additives such as carbon or glass fibres.

5 In order to simplify the production and the stock of construction element members the platform according to the invention may be such provided, said construction element members consist of at least two types of arched modules to cover the span between centre module and inside wall of the tower, and a number of two-piece arched modules to be mounted as a periphery ring next to the inside of the tower wall.

10 In order to make it possible to adapt the platform according to the invention to inside towers diameters within a certain diameter range each of said two-piece arched modules comprises a fixed part, which is mounted toward the centre of the platform, and a hinged part having the ability to bend from the horizontal position to an inclined position in order to fit varying diameters of the platform.

15 Alternatively, the platform according to the invention may be such provided that said fixed part may consist of a connection part of the hinged part being adapted to be connected with an outer end part of one of said arched modules or may even consist of one of said arched modules.

20 In order to minimize the necessary number of different module sizes the platform according to the invention may furthermore be such provided that said at least two types of arched modules are made such that the difference between the arched modules is the angle between the straight sides of the modules and there width, and that said modules
25 are adapted to be assembled by snap-in or spring locks.

In order to simplify a possible reinforcement of the platform according to the invention it may be advantageous that reinforcing steel bands or plates are squeezed in between the radial supporting beam members and between end parts of interconnected arched
30 modules.

As introductory mentioned the invention also relates to a system using an interactive computer program characterized in managing the number of different construction element members in the form of arched modules needed for the assembling of a plat-
35 form according to the invention and for controlling the stock of the necessary construc-

tion element members for assembling a platform of a specific size by varying the diameter thereof.

Description of the Drawing

In the following the invention is described in more detail with reference to the drawing,
5 in which:

Fig. 1 shows a perspective view of an embodiment of a platform construction according to the invention,

10 Fig. 2 shows a perspective top view of the platform cf. Fig. 1,

Fig. 3 shows a perspective view of the platform cf. Fig. 2 - seen from the lower side thereof,

15 Fig. 4 shows a perspective enlarged partial view of the platform cf. Fig. 3

Fig. 5 shows a perspective view of an embodiment of a centre construction element member with a number of radial supporting beam members for a platform according to the invention,

20

Fig. 6 shows a perspective view of the centre construction element member cf. Fig. 3 and with telescopic extended radial supporting beam members,

Fig. 7 shows an enlarged perspective view of the centre construction element member with shortened radial supporting beam members,
25

Fig. 8 shows a perspective view of an embodiment for an outer arched, two-piece construction element member according to the invention,

30 Fig. 9 shows a plane view illustration the number of different construction element members needed for the construction a platform according to the invention,

Fig. 10 shows a plane view illustrating the number of different construction element members needed for the construction of a platform with a diameter of 2000 mm according the invention,
35

Fig. 11 shows a plane view illustrating the number of different construction element members needed for the construction of a platform with a diameter of 3000 mm according to the invention,

5

Fig. 12 shows a plane view illustrating the number of different construction element members needed for the construction of a platform with a diameter of 4000 mm according to the invention,

10

Fig. 13 shows a plane view illustrating the number of different construction element members needed for the construction of a platform with a diameter of 5000 mm according to the invention,

15

Fig. 14 shows a plane view illustrating the number of different construction element members needed for the construction of a platform with a diameter of 5900 mm according to the invention,

20

Fig. 15 shows a combined plane and perspective view illustrating the proper angular position of the outer arched, two-piece construction element member by a platform according to the invention with a diameter of about 7000 mm,

25

Fig. 16 shows a combined plane and perspective view illustrating the proper angular position of the outer arched, two-piece construction element member by a platform according to the invention with a diameter between 6500-7000 mm,

30

Fig. 17 shows a combined plane and perspective view illustrating the proper angular position of the outer arched, two-piece construction element member by a platform according to the invention with a diameter between 6500-7000 mm,

35

Fig. 18 shows a combined plane and perspective view illustrating the proper angular position of the outer arched, two-piece construction element member by a platform according to the invention with a diameter close to 6500 mm,

40

Fig. 19 show a perspective view illustrating the placement of the basic centre construction element member with telescopic extended radial supporting beam members cf. Fig. 3 inside a laying windmill tower section,

Fig. 20 show a perspective view illustrating the mounting of the basic centre construction element member cf. Fig. 17 according to the invention,

5 Fig. 21 shows a perspective view illustrating the mounting of an innermost ring of arched construction element members between the radial supporting beam members of a platform according to the invention,

10 Fig. 22 shows a perspective view illustrating the mounting of the next ring of arched construction element members between the radial supporting beam members of a platform according to the invention,

15 Fig. 23 shows a perspective view illustrating the mounting of the still next ring of arched construction members between the radial supporting beam members of a platform according to the invention,

Fig. 24 shows a perspective view illustrating the mounting of the outermost ring of arched, two-pieced construction members of a platform according to the invention,

20 Fig. 25 shows on computer screen how the calculation takes place for determination of the needed number of different constructions element members for a platform having a diameter of 483 mm in the upper line of the screen ,

25 Fig. 26 shows a perspective view illustrating how an arched steel place is fetched in between the ring-shaped rows of arched construction element members in order to reinforce the platform according the invention,

30 Fig. 27 shows on a computer screen how the prior art platform construction takes place by creating individually shaped plate items of aluminium floor plate, and

Fig. 28 shows a perspective view illustrating the prior art of cutting up of the individually shaped aluminium floor plates for a specific windmill platform.

Detailed Description of the Invention

35 Figs. 1-4 show a preferred embodiment of a platform 2 according to the invention for in situ mounting inside a windmill tower.

Fig. 9 illustrates a dynamic picture from the managing system where the placement of the cursor on the construction element members shown in the left hand side of Fig. 9 automatically highlight the following construction element members shown in the right hand side of Fig. 9:

A basic centre module 4 comprising twelve radial, telescopic supporting beam members 6, the outer end part 8 thereof consist of tubes of by way of example metal having possible rectangular cross section, twelve arched inner modules 10, two rows of further arched intermediate modules 12, where the second row also comprises narrow adapting modules 14, and finally a outermost row of a great number of two-piece modules 16 (Fig. 8) comprises a fixed part 18, which is mounted toward the centre of the platform 2, and a hinged part 20 having the ability to bend from the horizontal position to an inclined position in order to fit varying diameters of the platform 2.

A platform for mounting inside the tower near the top thereof may consist of a basic module 4 and only twelve arched inner modules 10, the outer end surfaces of which may be directly connected to the inside wall 22 of the tower 24 possibly by means of suitable mountings. In other words such top platform need not the comprise the radial, telescopic supporting beam members 6 Figs. 5-7 show centre module 4 comprising twelve radial supporting beam members 6, and Fig. 6 furthermore shows the outer end parts 8 of the radial, telescopic supporting beam members 6, while the twelve arched inner modules 10 are shown in all three figures.

Figs. 10-14 illustrate a system using an interactive computer program for managing the number of different construction element members in the form of basics centre module 4, arched modules 10, 12, 14 and possibly two-piece modules 16 needed for the assembling of a platform according to the invention by varying the diameter of the platform 2 from 2000mm to 5900 mm as indicated in the upper left corner of Figs. 10-14.

By way of example Fig. 14 illustrates the following total number of different construction element members needed for assembling of a platform 2 having a diameter of 5900 mm:

Basic centre module 4:

1

	Radial telescopic supporting beam members 6:	12
	Arched inner modules 10:	12
	Arched intermediate modules 12:	158
	Two-piece hinged modules 16:	103
5	Narrow adapting modules 14:	165

Figs. 15-18 illustrate the dynamic bending of said hinged part 20 of said two-pieces module 16 from horizontal position to a specific inclined position in relation to inside wall 22 of the tower 24 by varying diameter of the platform 2.

10

In the left hand side of the figures 15-18 the actual inclined position of the hinged part 20 is shown in perspective views, while the actual height position of the platform 2 inside the tower 24 is indicated on the ruler in the right hand side of the figures.

15

Figs. 19-24 illustrate the mounting and the assembling of the platform 2 inside a lying part of a windmill tower 24. The basic centre module 4 including twelve radial, telescopic supporting beam members 6 still in a not extending position is transported inside the tower 24 on a special vehicle 26. In correct position the basic centre module 4 is raised into vertical position centrally in the tower 24, before the radial, telescopic supporting beam members 6 are radial extended and the outer parts 8 thereof is connected rigidly to the inside wall 22 of the tower (Fig. 20).

20

Then the twelve inner arched modules 10 if not already mounted are mounted by snap-in or spring locks, as indicated in Fig. 21. Then follow the mounting of first ring-shaped row of intermediate arched modules 12, as indicated in Fig. 22. Then follow the mounting of next ring-shaped row of both intermediate arched modules 12 mixed with narrow adapting modules 14, as indicated in Fig. 23, and finally follow the mounting of the outermost ring-shaped row of two-piece modules 16, as indicated in Fig. 24.

25

30

Regardless the size of the tower 24 all platforms 2 will consist of a basic centre module 4 and twelve arched inner modules 10 around the basic centre module 4. The arched modules 10, 12, 14 are such provided that there is a gap/groove between the arched modules 12, 14 serving as guiding channels for the radial, telescopic supporting beam

member 6, which are elongated from the basic centre module 4 to the inside wall 22 of the tower 24.

5 The platforms 2 comprise a central, circular removable cover - however some of the uppermost platforms 2 may often be without such central covers - because often uppermost platforms may need a central passage for possible twisting electrical cables, which from there and down through the tower is mounted on the inside wall by means of special cable clamps.

10 As furthermore indicated in Figs. 22-24 a number of reinforcing arched bands 28 made from steel are squeezed in between the radial supporting beam members 6 and between end parts of interconnected arched modules 12, 14, 16 (Fig. 26).

15 In order to ensure the necessary carrying ability in the span between the radial, telescopic supporting beam members 6 all the arched modules 10, 12, 14 are clicked together around vertical steel bands 28, which run from supporting beam member 6 to supporting beam member 6, where the rings of arched modules 10, 12, 14 meet.

The steel bands or plates 28 give strength in the vertical direction and the arched plastic modules 10, 12, 14 - snapped on around the steel bands 28 - supports the steel
20 bands 28 from collapsing. In this manner it's possible to obtain an improved strength and stiffness of the platform 2 with very little steel. The steel bands or plates 28 are only mounted where improved strength or stiffness is needed.

Fig. 25 illustrates the monitoring and the controlling the stock of the necessary construction element members for assembling a platform of a specific size by varying the
25 diameter thereof.

The computer screen of Fig. 25 show the specific numbers of the different modules needed for assembling of a platform having a diameter of 483 cm, namely as indicated
30 in the "need" line of the screen: One basic centre module 4 including twelve radial, telescopic supporting beam members 6, twelve arched inner modules 10, 78 arched intermediate modules 12, 86 two-piece modules 16 and 42 adapting modules 14.

35 Figs. 27 and 28 illustrate the prior art situation, where the construction of platforms of the actual type of platforms today are made from individually engineered and manufac-

tured construction element members for each tower in a custom size. The platforms are made from aluminium floor plates that are bended to be self-supporting.

The concept, design and manufacturing of the platform according to the present invention will solve or reduce the following issues:

- 5 • Design time and costs - because the platform is modular based and there is no need for engineering.
- Customer friendly regarding development, costs and mounting - because there are only a few modules and these may form all variants of platforms from 2000 mm to at least 8000 mm in diameter, and the system has standard solutions for
10 all needed variants.
- Documentation - only standard modules, there is only needed a list with a total number of modules.
- Manufacturing - made from standard modules by way of example made from plastics that can be manufactured in big quantum at any location of the world.
- 15 • Mounting - the modules are by way of example made from plastic the modules may be clicked together. There is a minimum of assembling with screws, bolts etc.
- Handling - may be manufactured in big quanta and transported in large containers. At the same time the weight is minimal, which reduces the handling when
20 mounted by way of example in a windmill tower.
- Logistics – made from standard modules by way of example in plastics that may be produced in the entire world.

In order to adjust the platform in accordance with special customer requirements it may
25 be possible to substitute a number of arched modules and even parts of said radial, telescopic supporting beam members with a frame and a possible belonging manhole cover. And such a frame may preferably be such adapted that is may be connected to the platform by snap-in or spring locks - that is without using screws, bolts and the like.

30 Alternatively, openings of any form may even be made by cutting in the platform and be provided with a similar shaped frame in order to stiffening the platform area around such opening.

CLAIMS

1. A platform (2), in particular an interior platform for a tubular tower - by way of example a windmill tower (24) made from steel - and more specific a platform (2) adapted to be assembled in situ from a number of construction element members in order to fit the inside wall (22) of the tower (24), **characterized in** comprising a basic centre module (4), a number of radial, telescopic supporting beam members (6), and a number of said construction element members in the form of arched modules (10, 12, 14) being independent of the diameter of the platform (2).
2. A platform (2) according to claim 1, **characterized in** that inner end parts of said radial, telescopic supporting beams members (6) being rigidly connected with said basic centre module (4).
3. A platform (2) according to claim 1, **characterized in** that outer end parts (8) of said radial, telescopic supporting members (6) being adapted to be connected to the inside wall (22) of the tower (24) by means of mounting members by way of example comprising magnets.
4. A platform (2) according to claim 1, **characterized in** that said basic centre module (4), said construction element members and at least inner parts of said radial supporting beam members (6) are made by moulding, which moulding material if plastics may possibly be reinforced by means of suitable strength giving additives such as carbon or glass fibres.
5. A platform (2) according to claim 1, **characterized in** that said construction element members consist of at least two types of arched modules (10, 12, 14) to cover the span between basic centre module (4) and inside wall (22) of the tower (24), and a number of two-piece arched modules (16) to be mounted as a periphery ring next to the inside wall (22) of the tower (24).
6. A platform (2) according to claim 5, **characterized in** that each of said two-piece arched modules (16) comprises a fixed part (18), which is mounted toward the centre

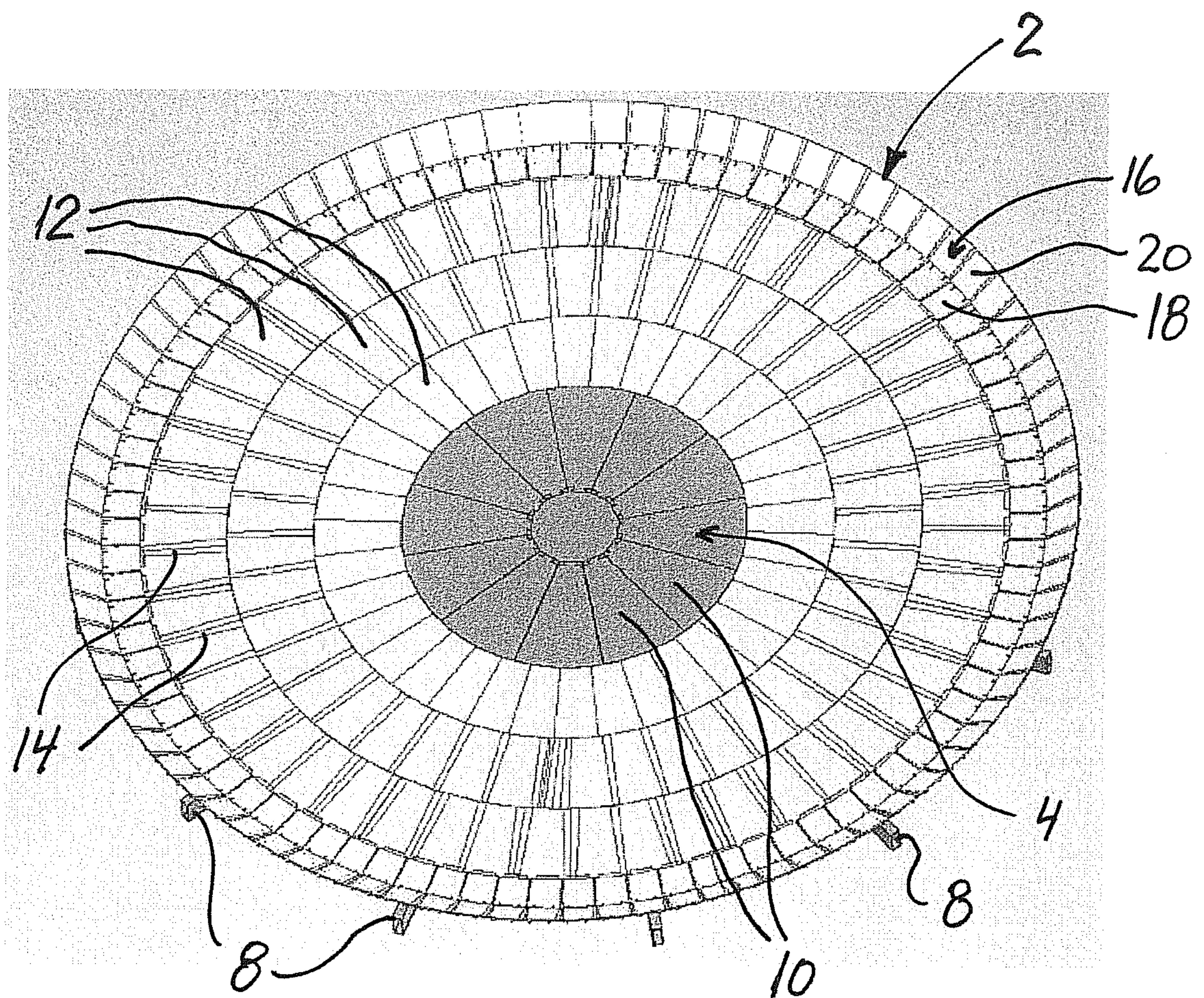
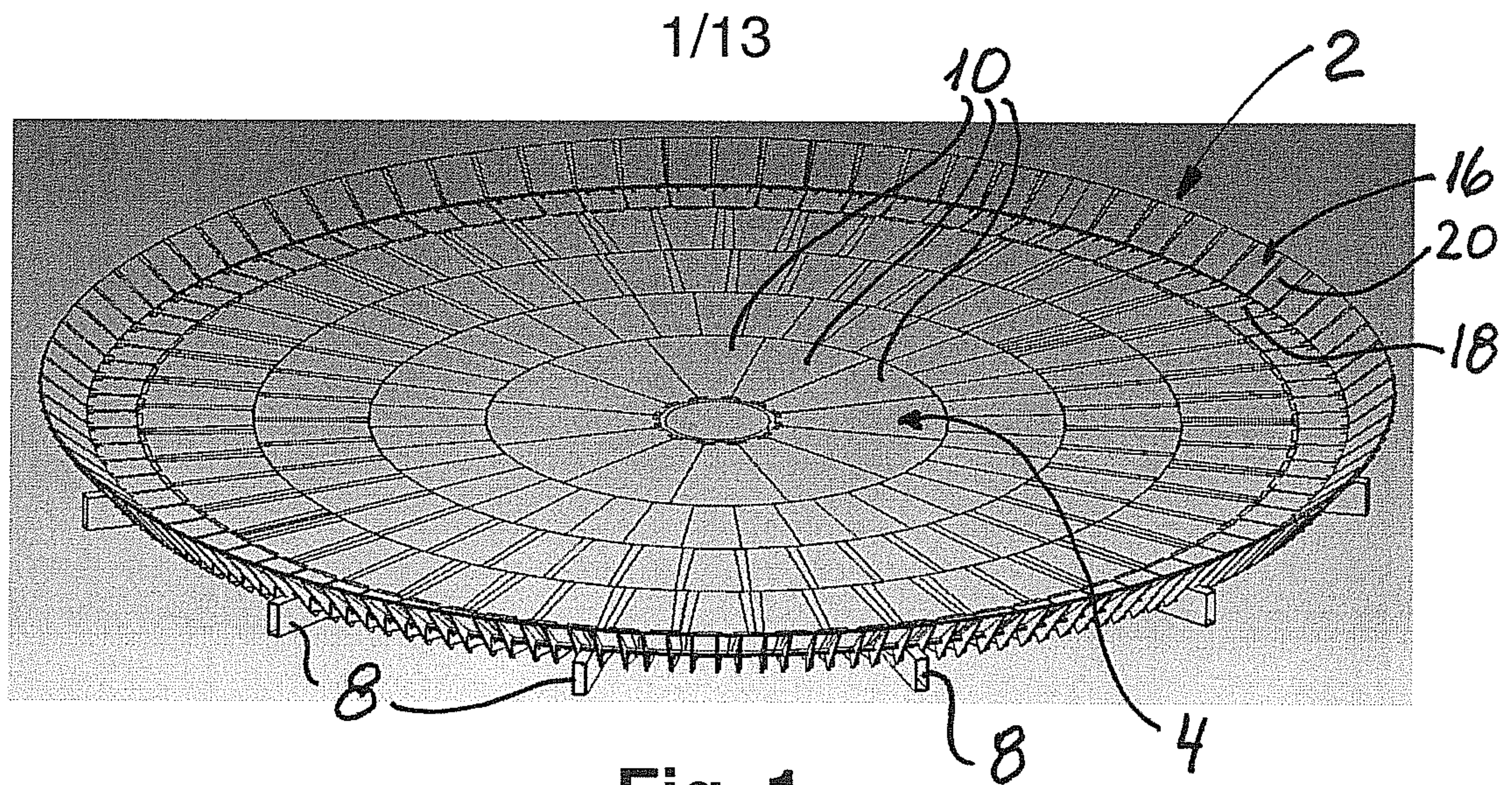
of the platform (2), and a hinged part (20) having the ability to bend from the horizontal position to an inclined position in order to fit varying diameters of the platform (2).

5 7. A platform (2) according to claim 5, **characterized in** that said fixed part may consist of a connection part of the hinged part being adapted to be connected with an outer end part of one of said arched modules (10, 12) or may even consist one of said arched modules (10, 12).

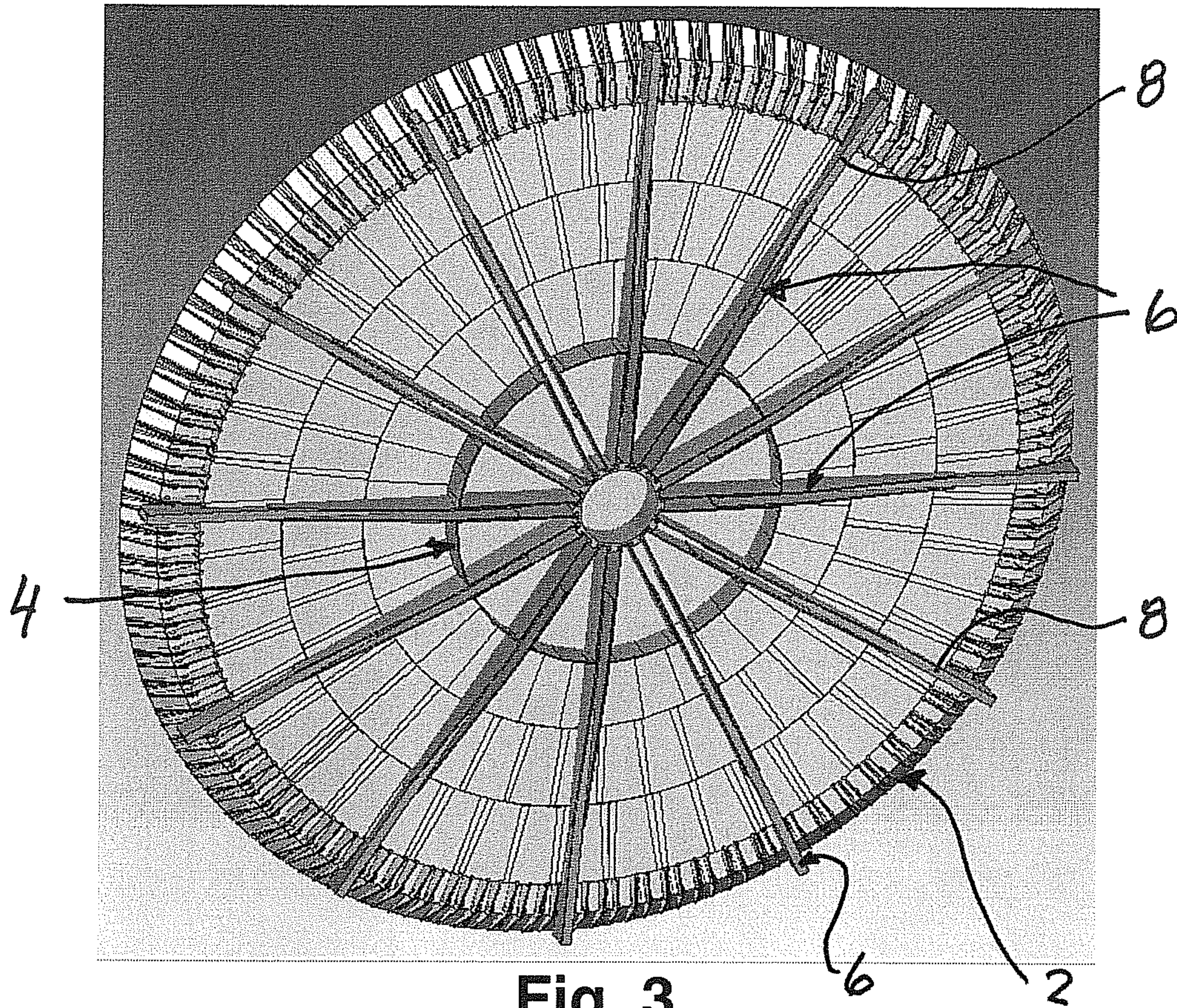
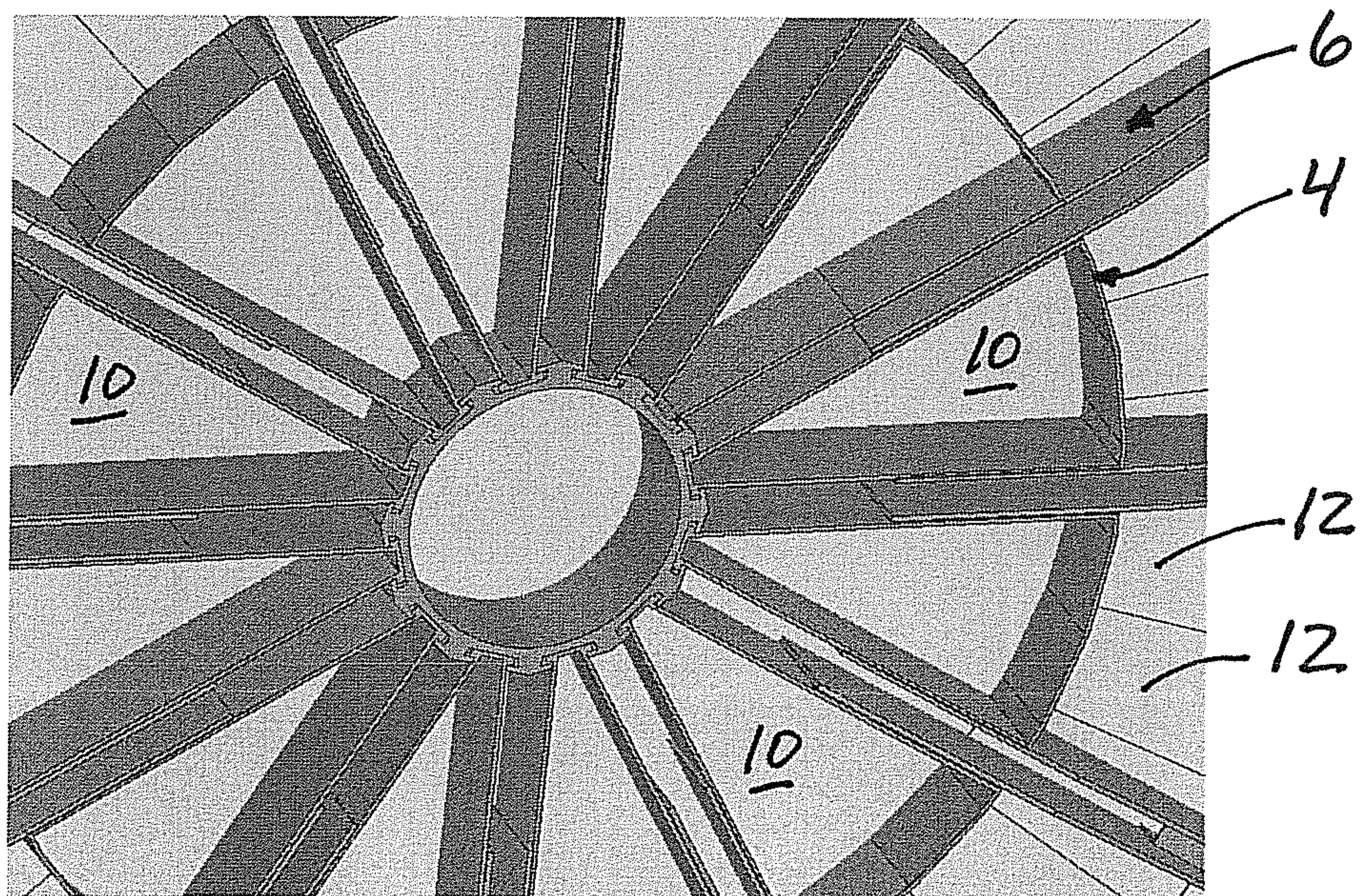
10 8. A platform (2) according to claim 5, **characterized in** that said at least two types of arched modules (10, 12, 14) are made such that the difference between the arched modules is the angle between the straight sides of the modules and there width, and that said modules are adapted to be assembled by snap-in or spring locks.

15 9. A platform (2) according to claim 1, **characterized in** that reinforcing steel bands or plates (28) are squeezed in between the radial, telescopic supporting beams (6) and between end parts of interconnected arched modules (10, 12, 14).

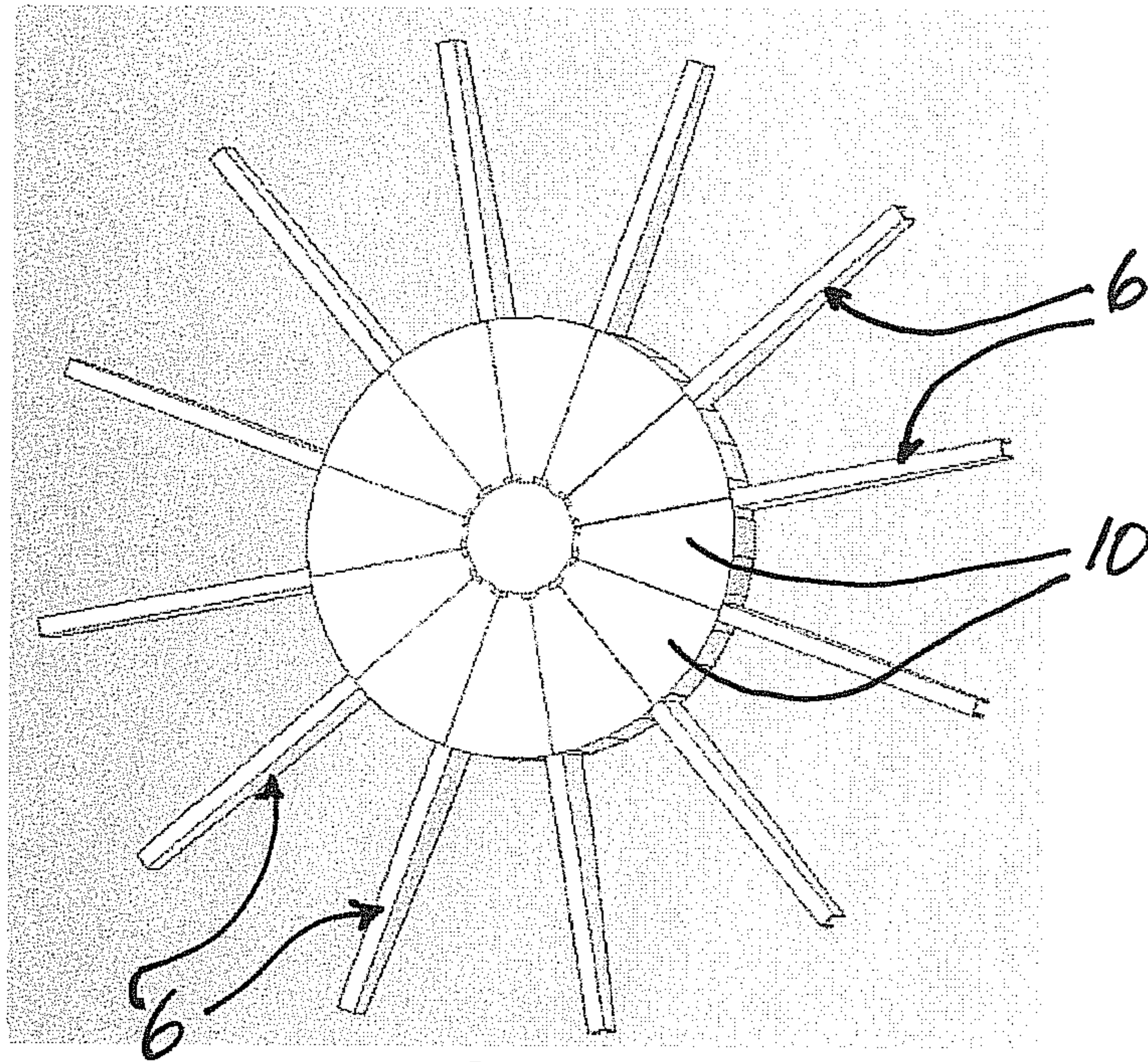
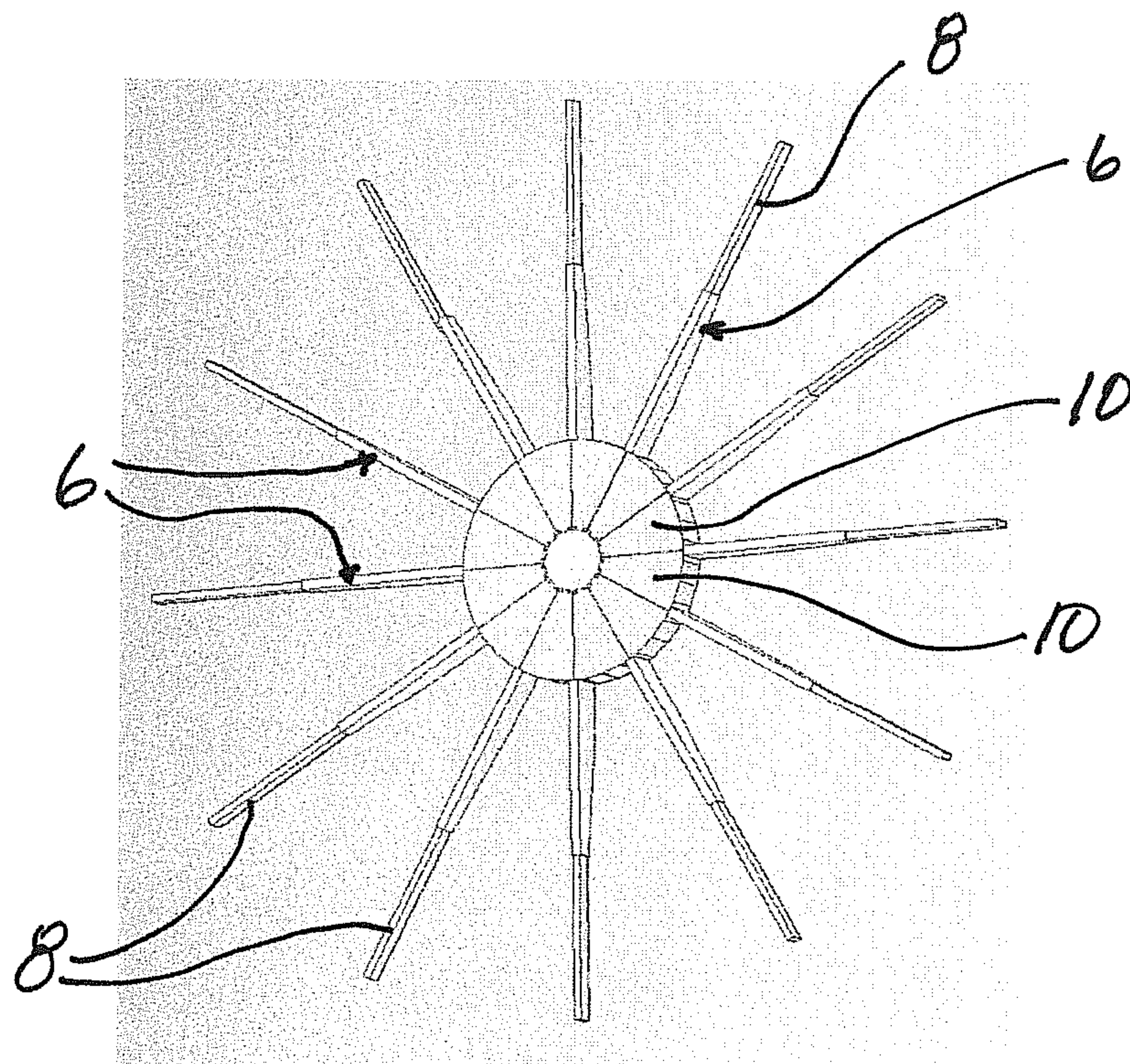
20 10. A system using an interactive computer program for managing the number of different construction element members in the form of arched modules (10, 12, 14) needed for the assembling of a platform (2) according to the invention and for controlling the stock of the necessary construction element members for assembling a platform of a specific size by varying the diameter thereof.



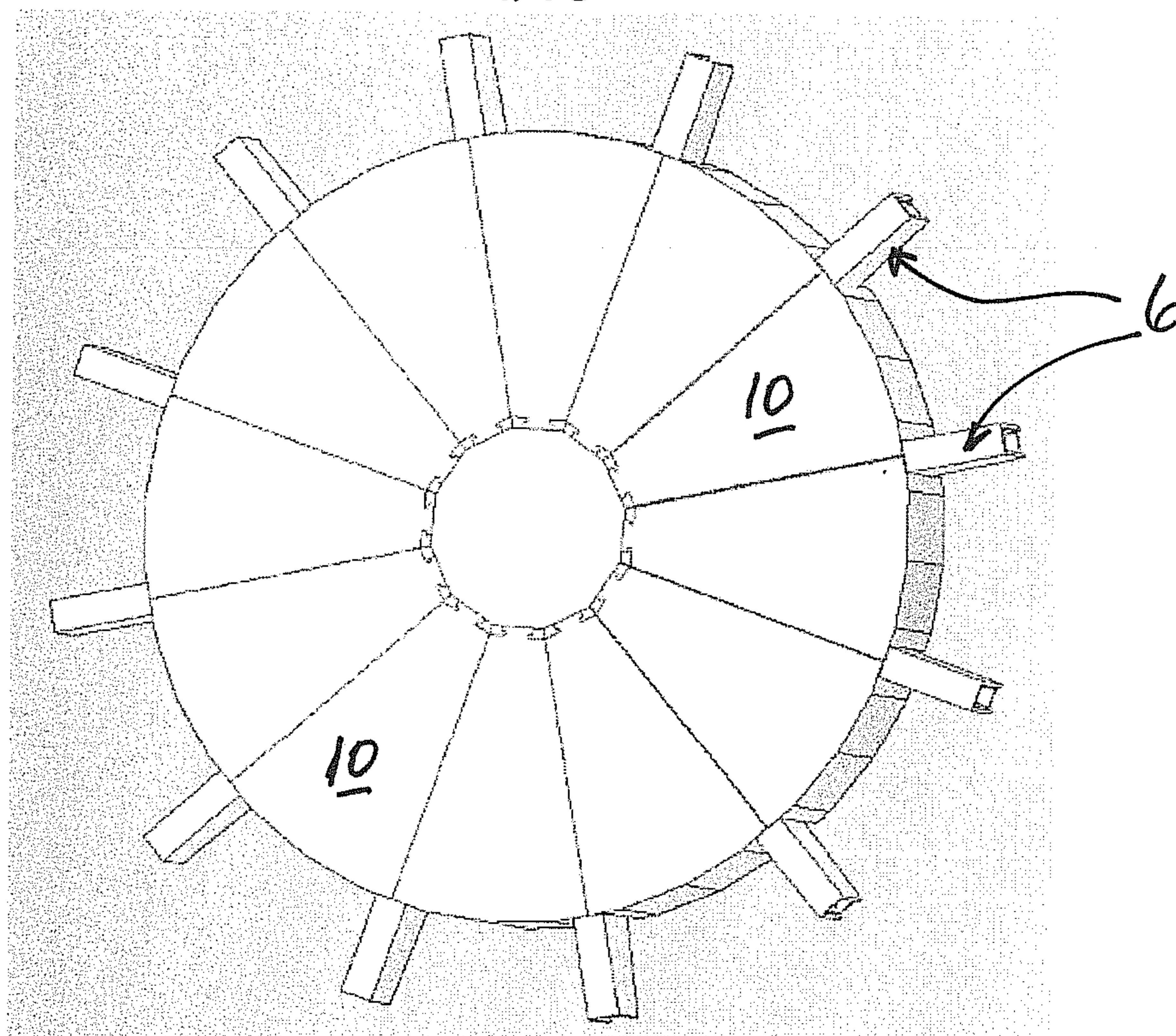
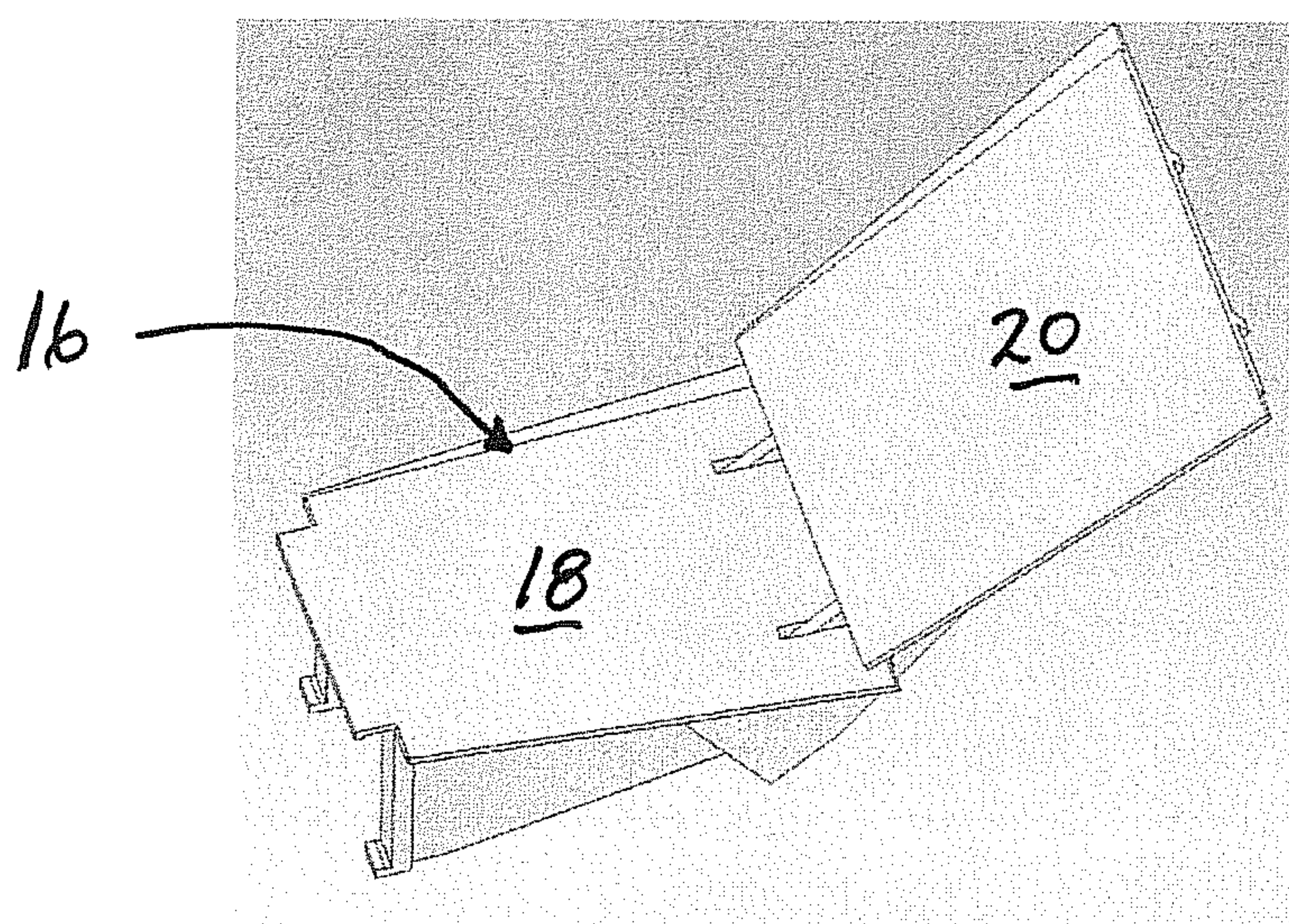
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**Fig. 3****Fig. 4**

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**Fig. 5****Fig. 6**

4/13

**Fig. 7****Fig. 8**

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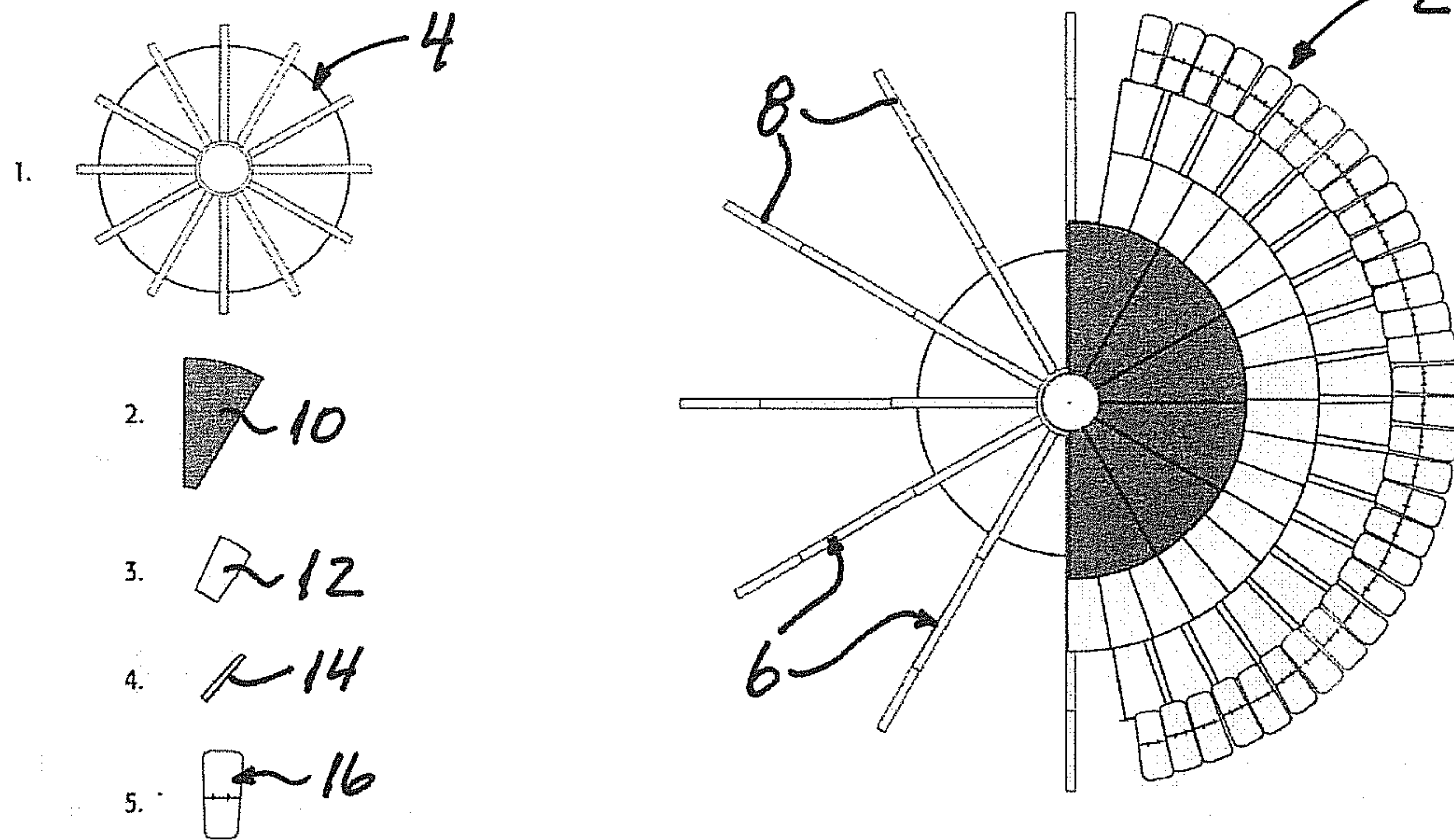


Fig. 9

5.9 m	
5 m	
4 m	
3 m	
2 m	DRAG ME
Component	Need
	1
	12
	0
	0
	0

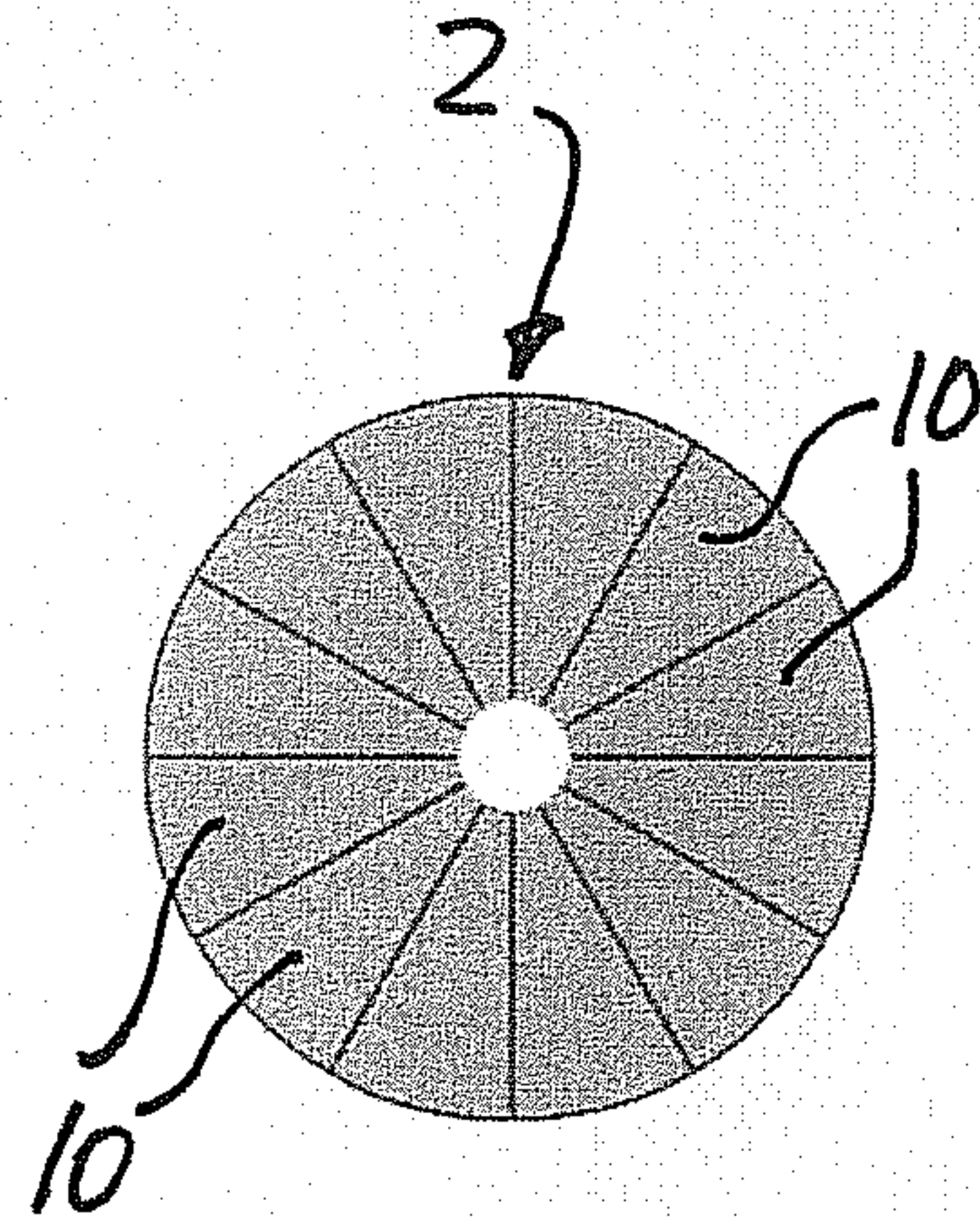


Fig. 10

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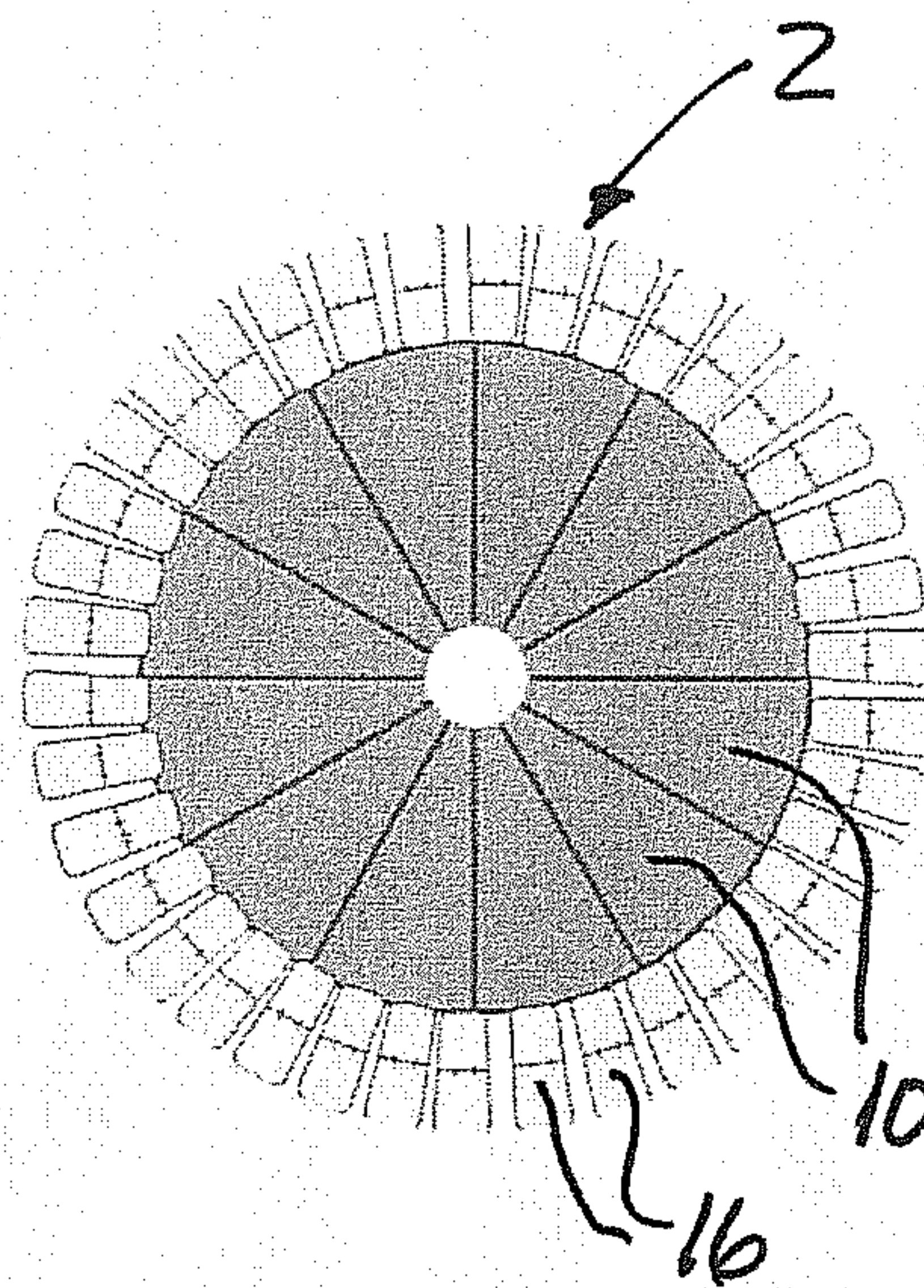
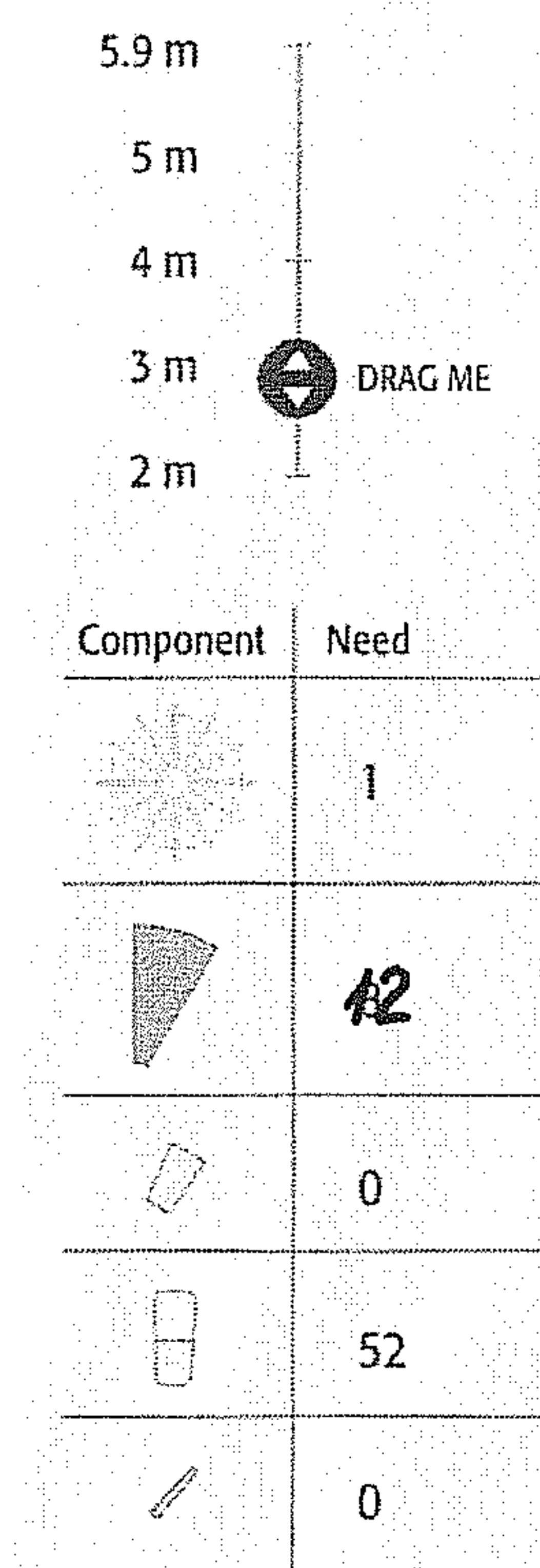


Fig. 11

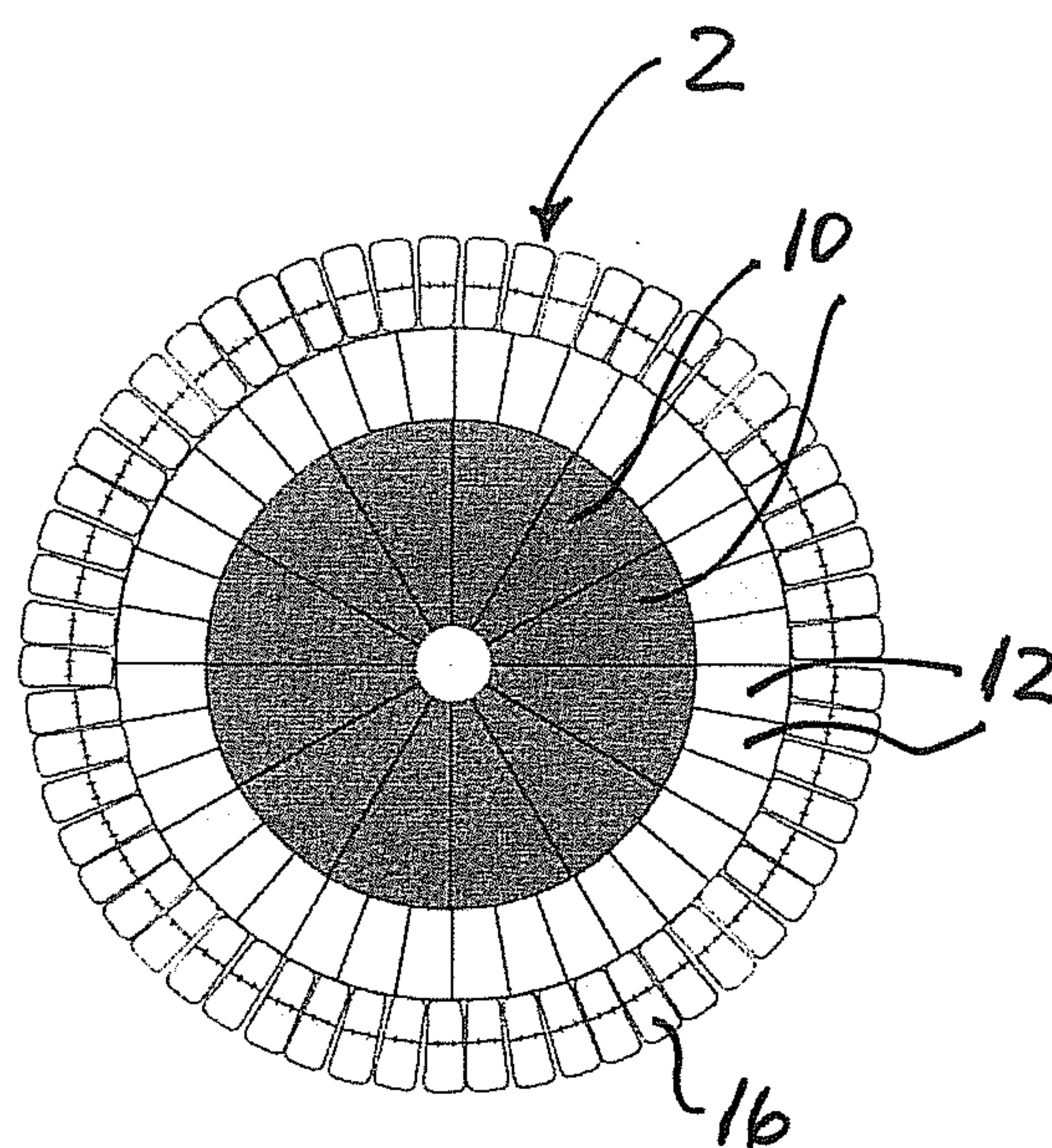
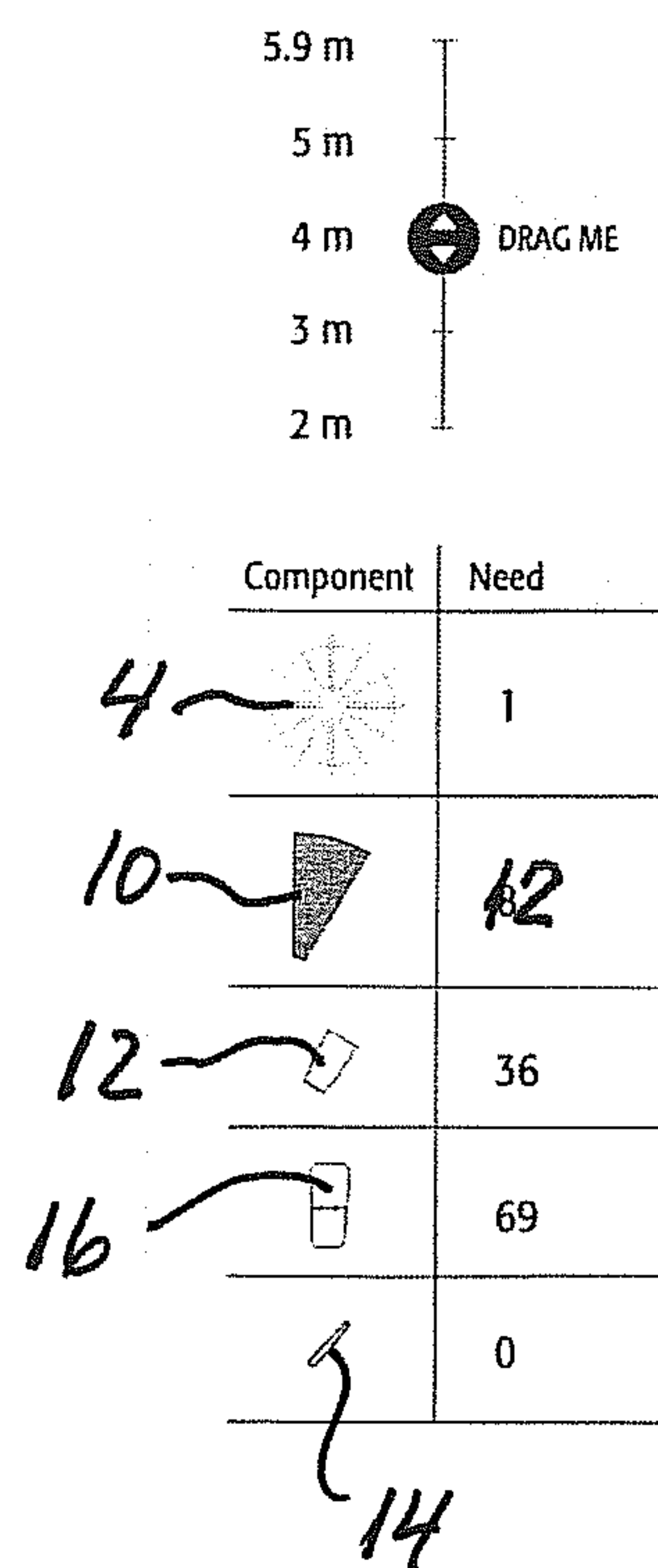
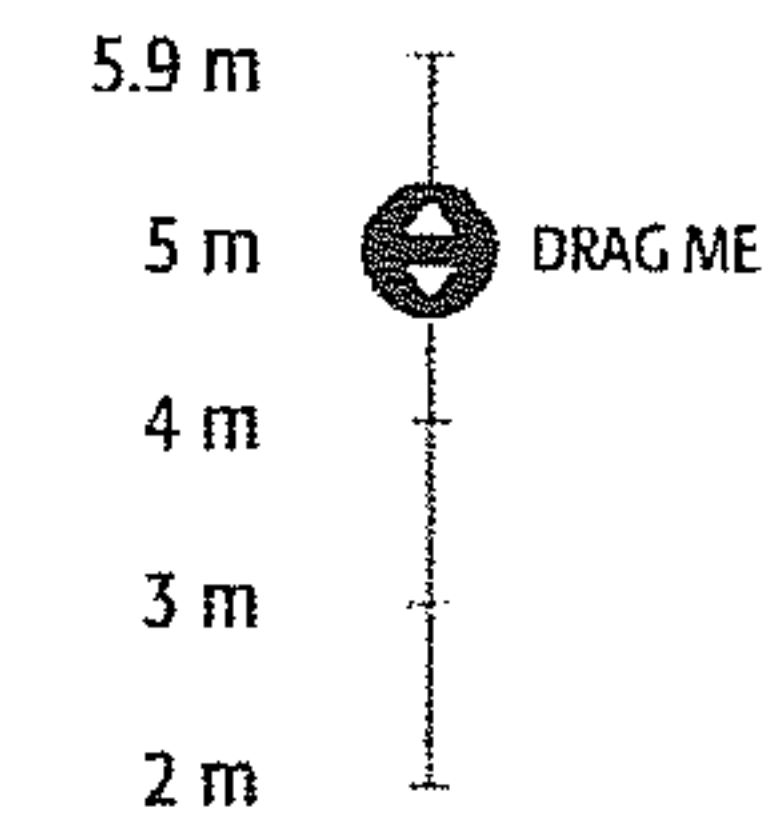


Fig. 12

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Component	Need
	1
	12
	78
	86
	42

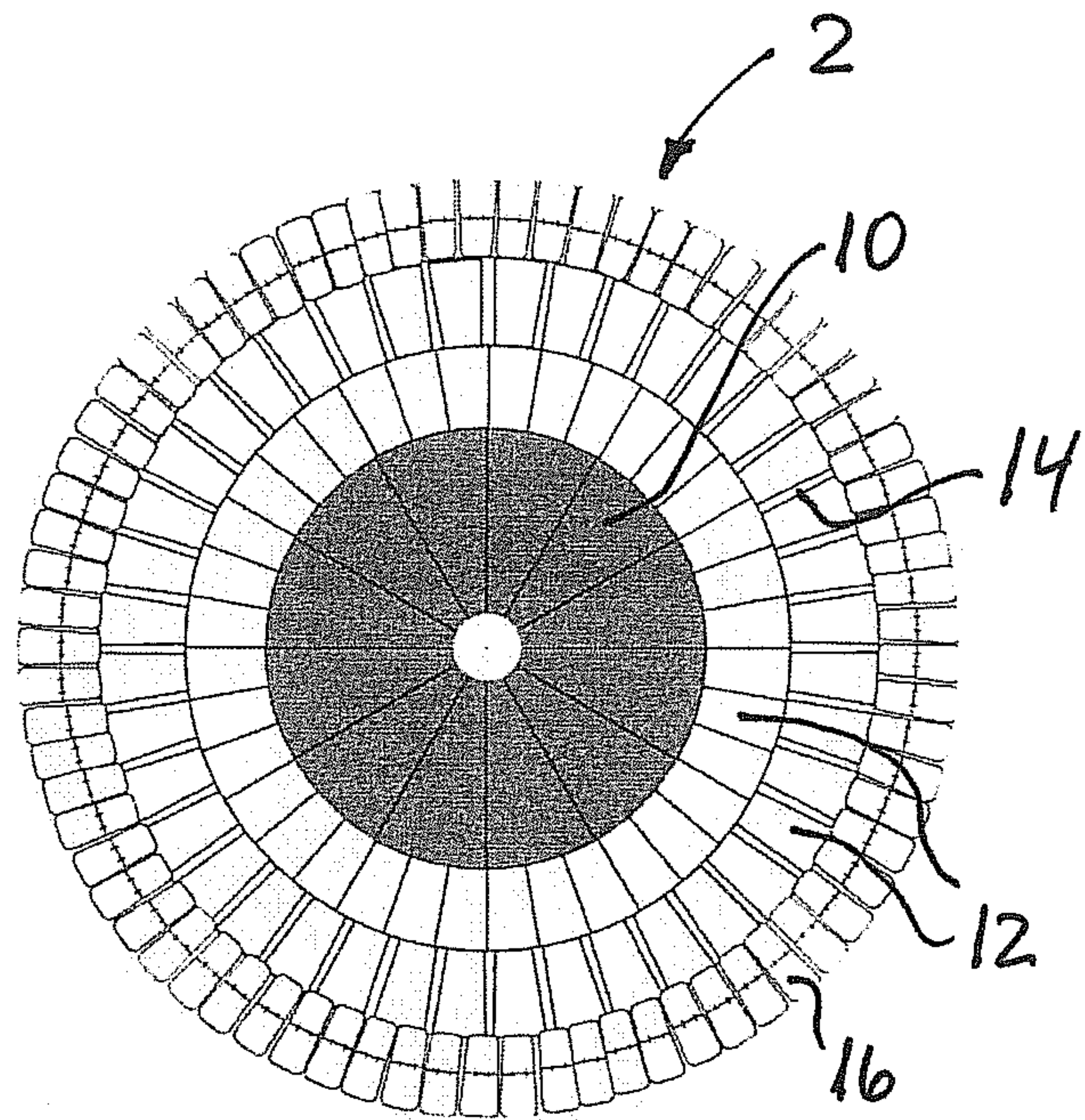
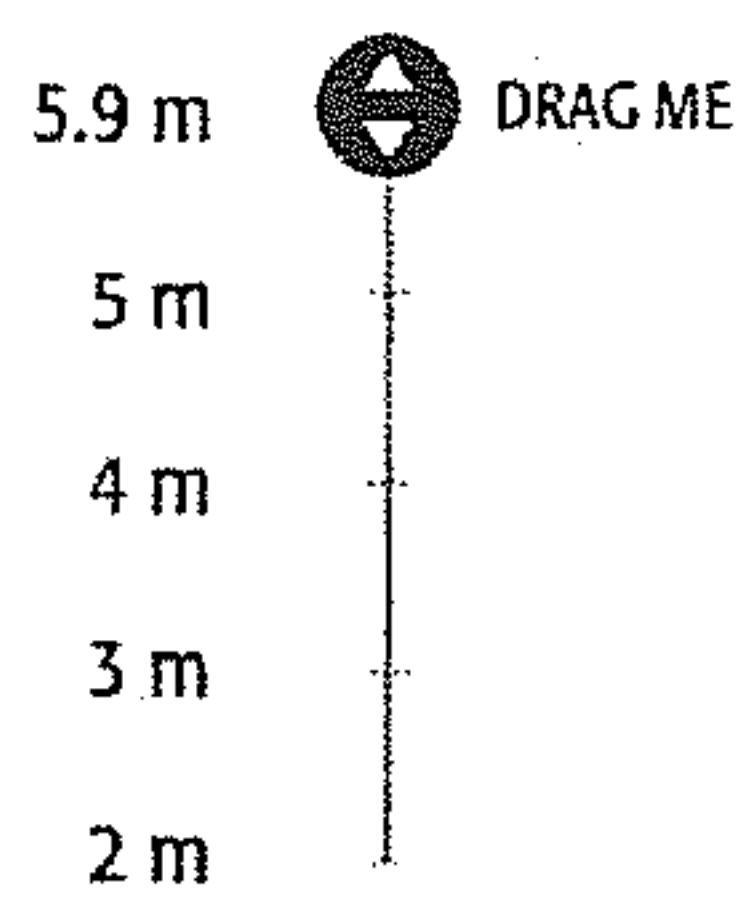


Fig. 13



Component	Need
4-	1
10-	12
12-	158
16-	103
14-	165

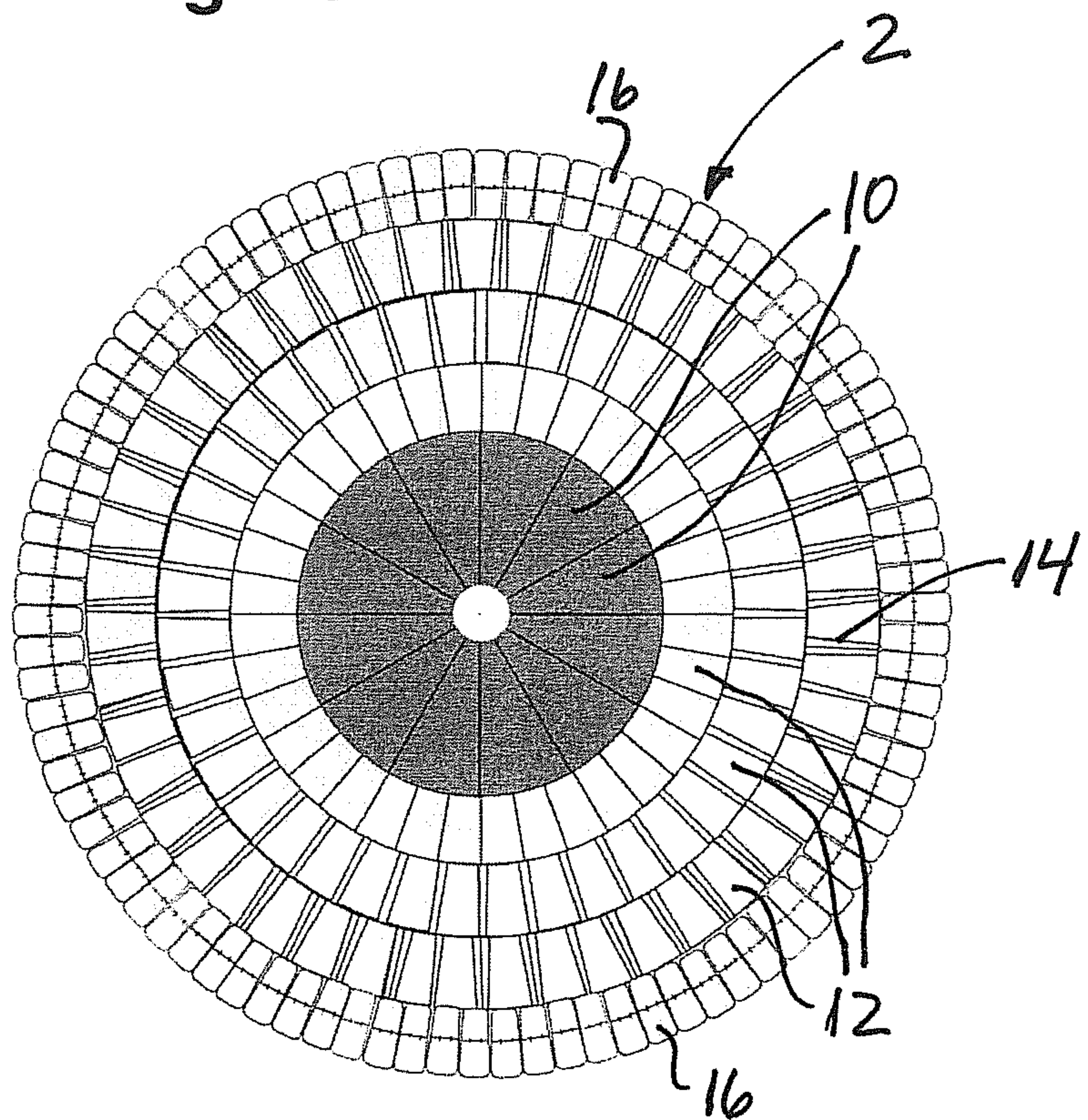


Fig. 14

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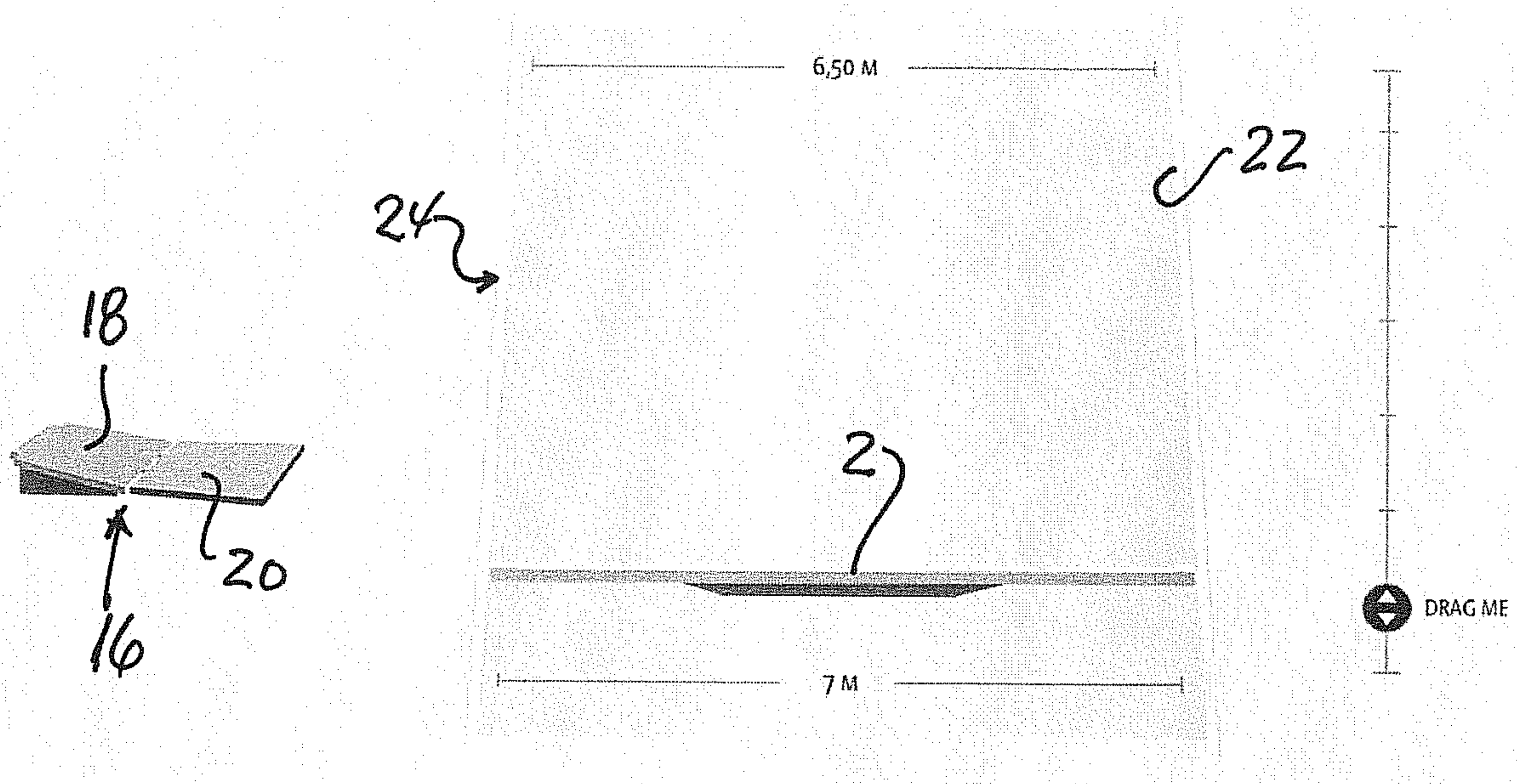


Fig. 15

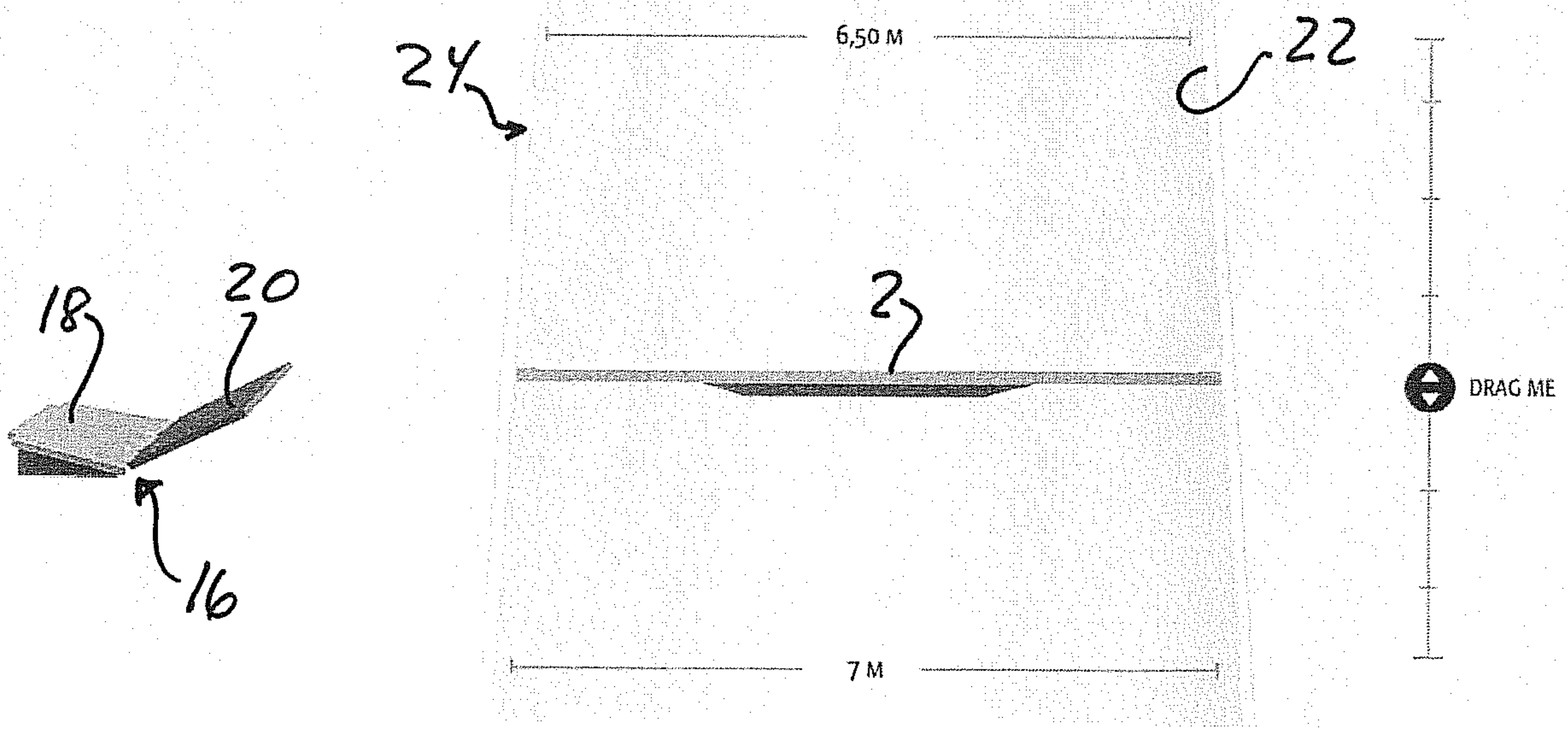


Fig. 16

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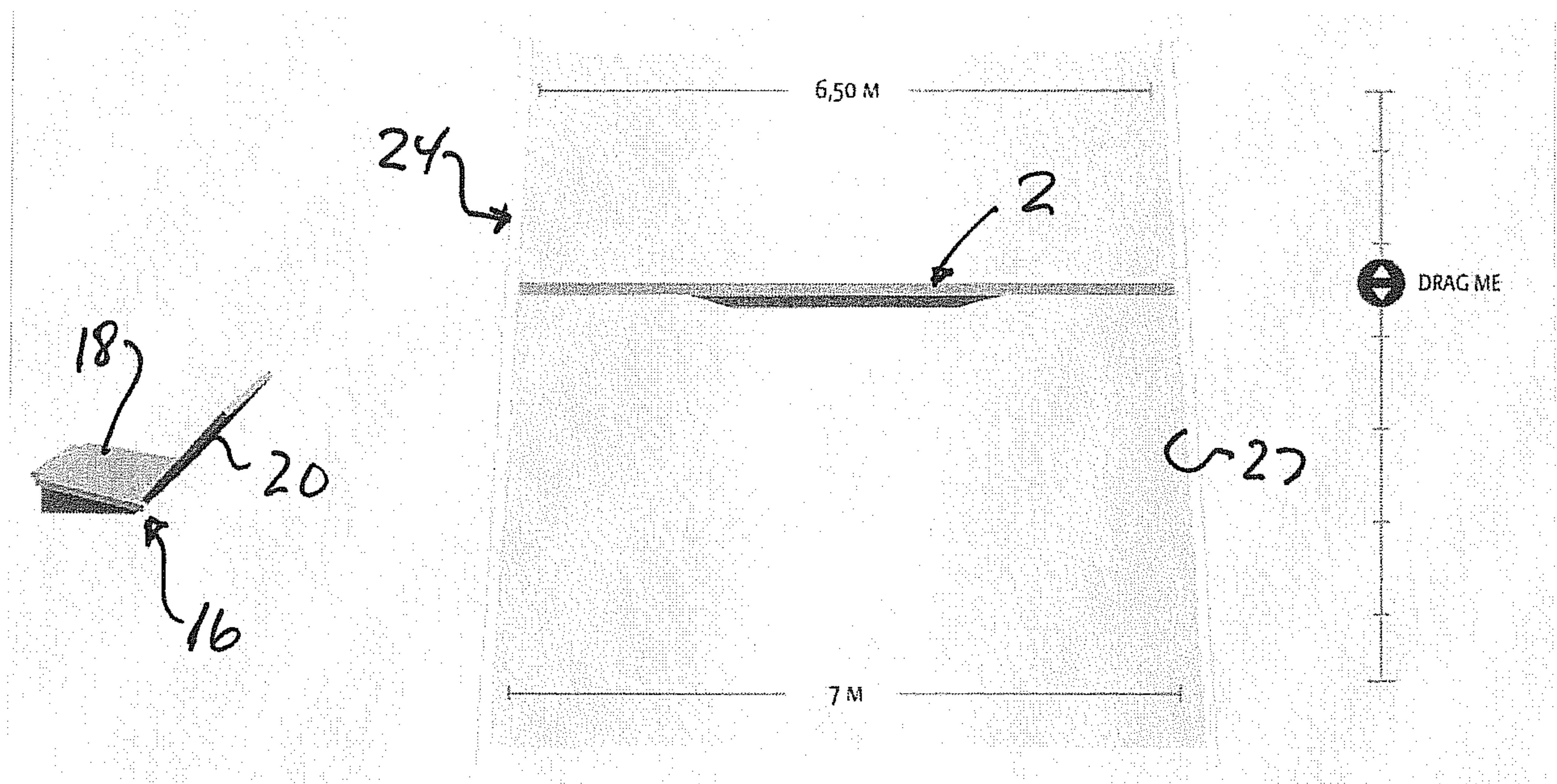


Fig. 17

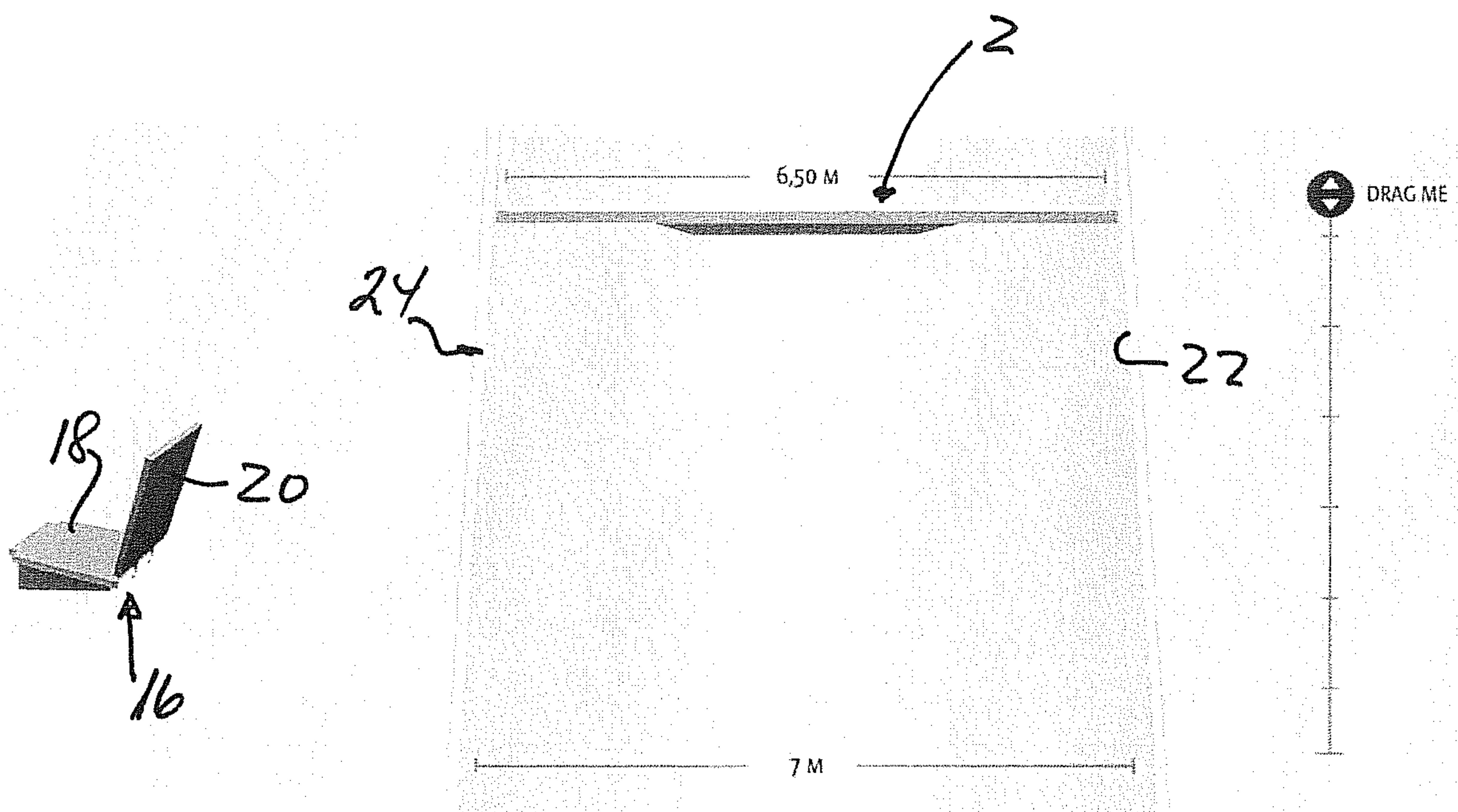


Fig. 18

10/13

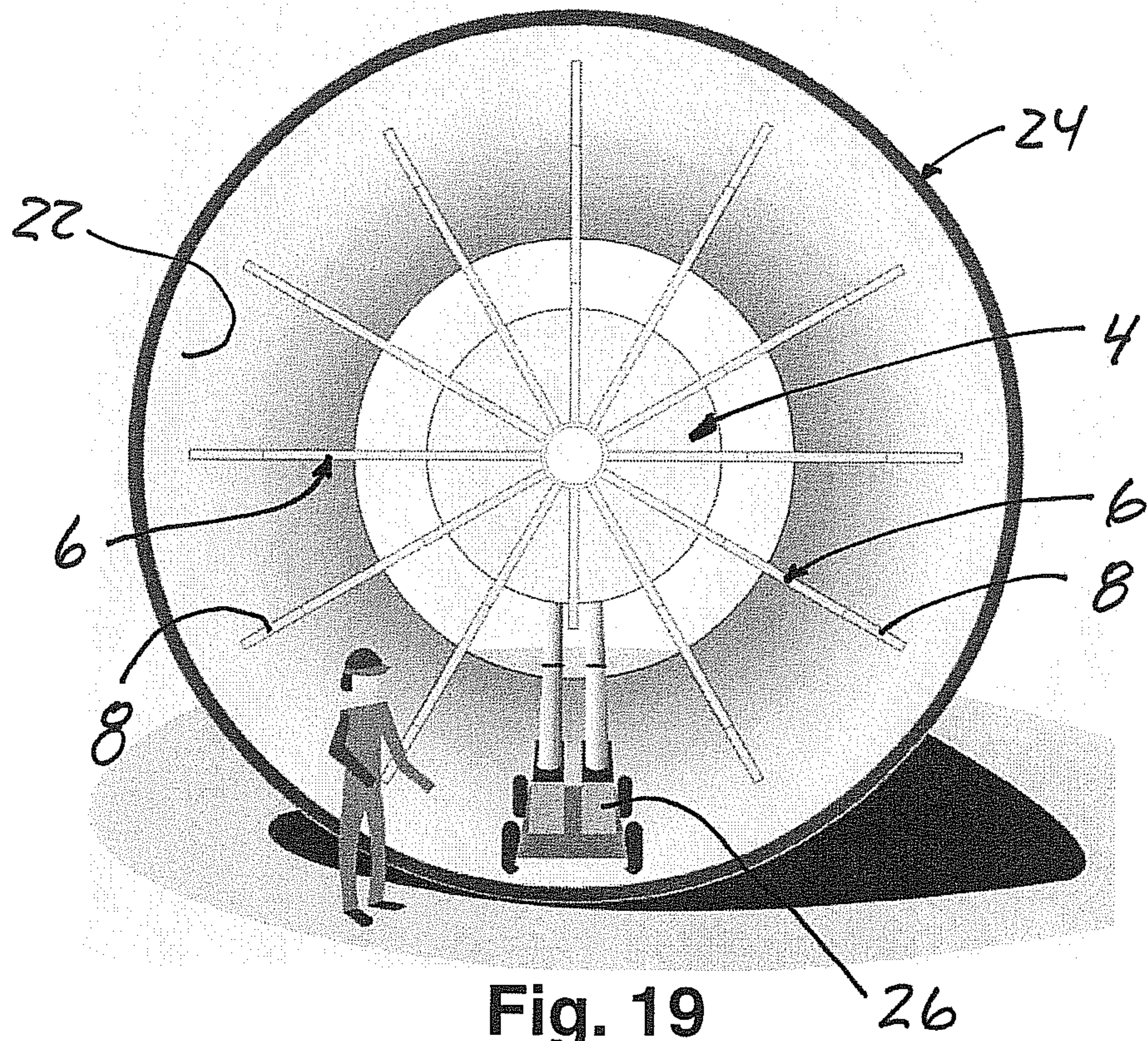


Fig. 19

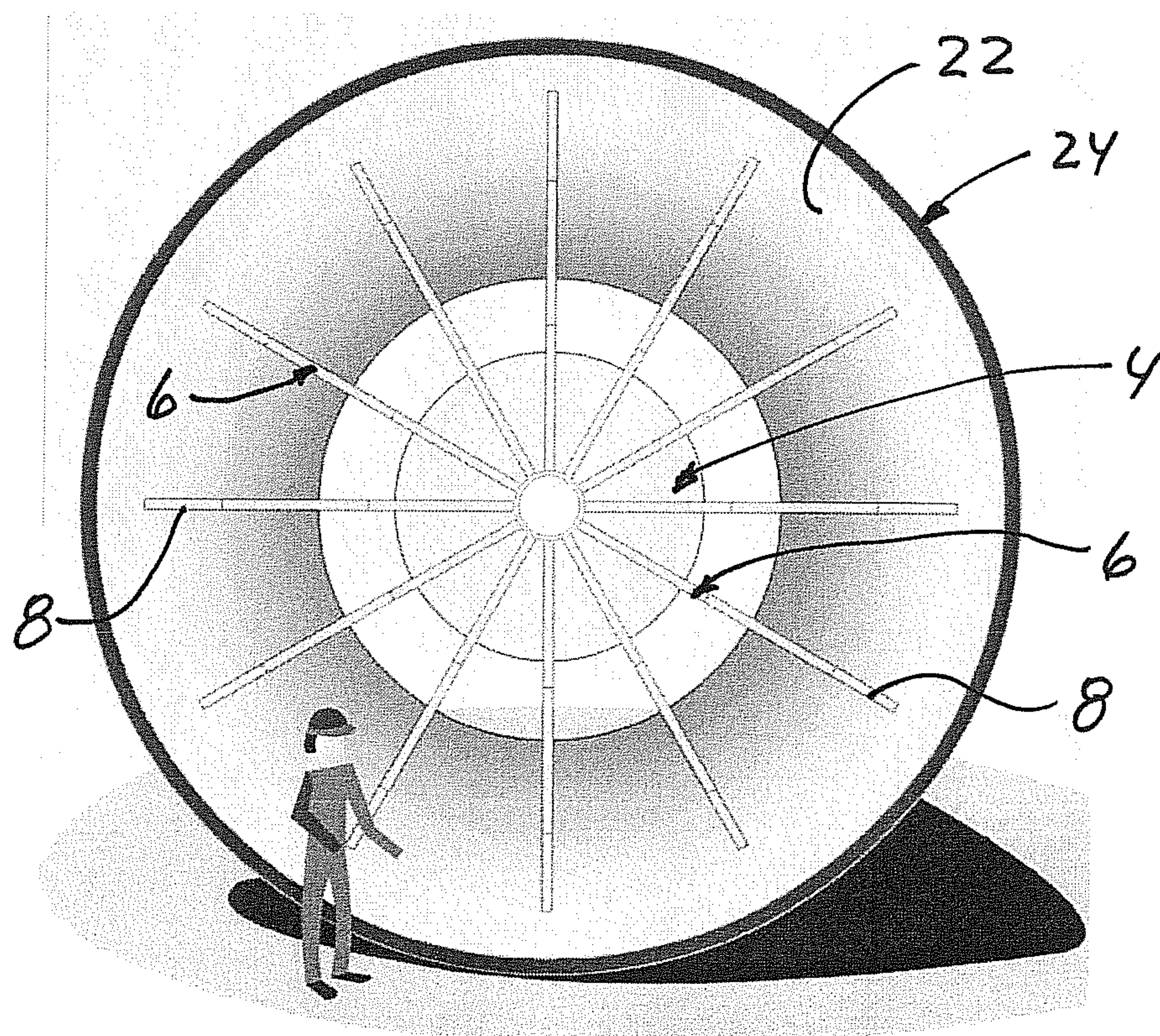


Fig. 20

11/13

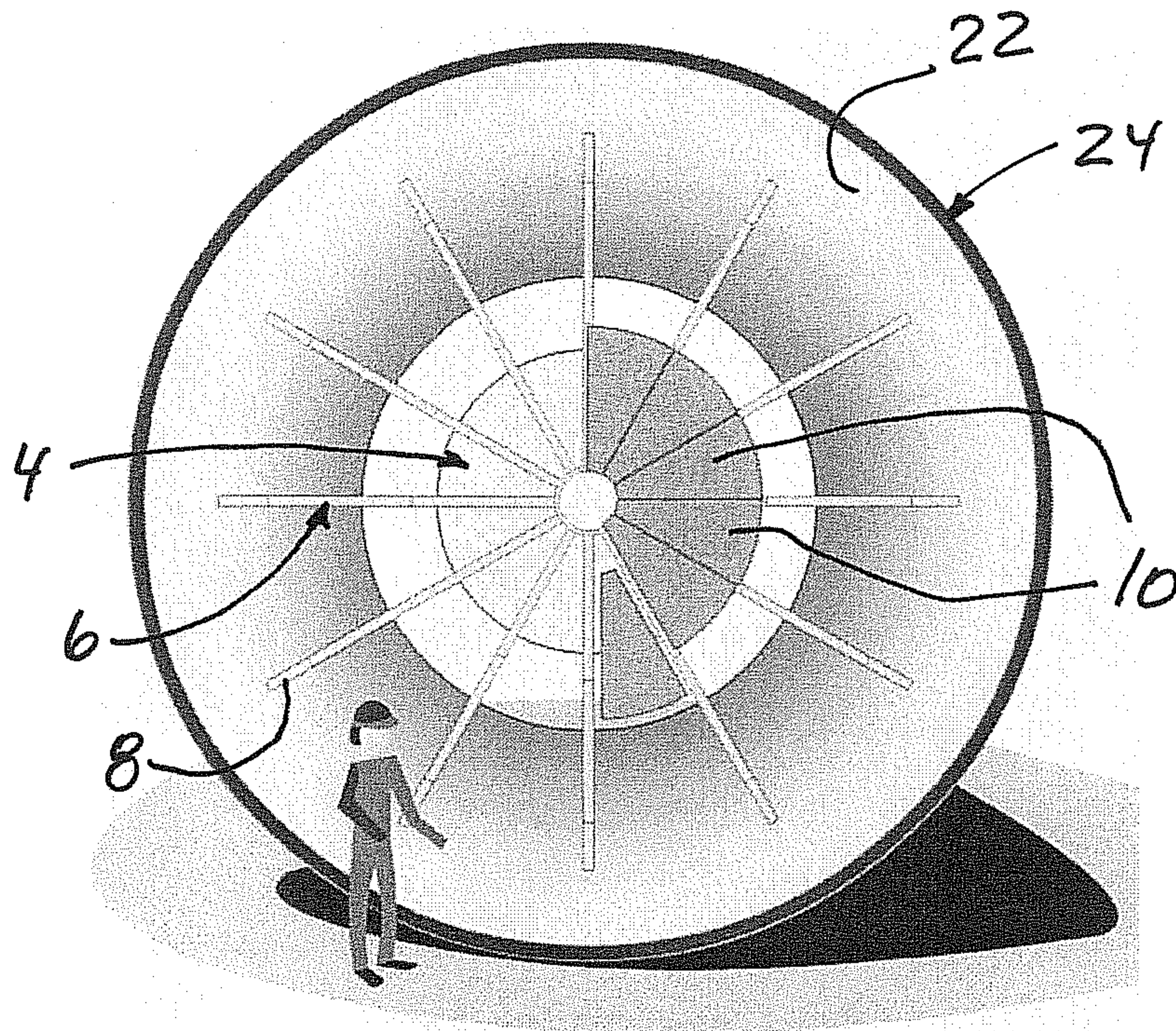


Fig. 21

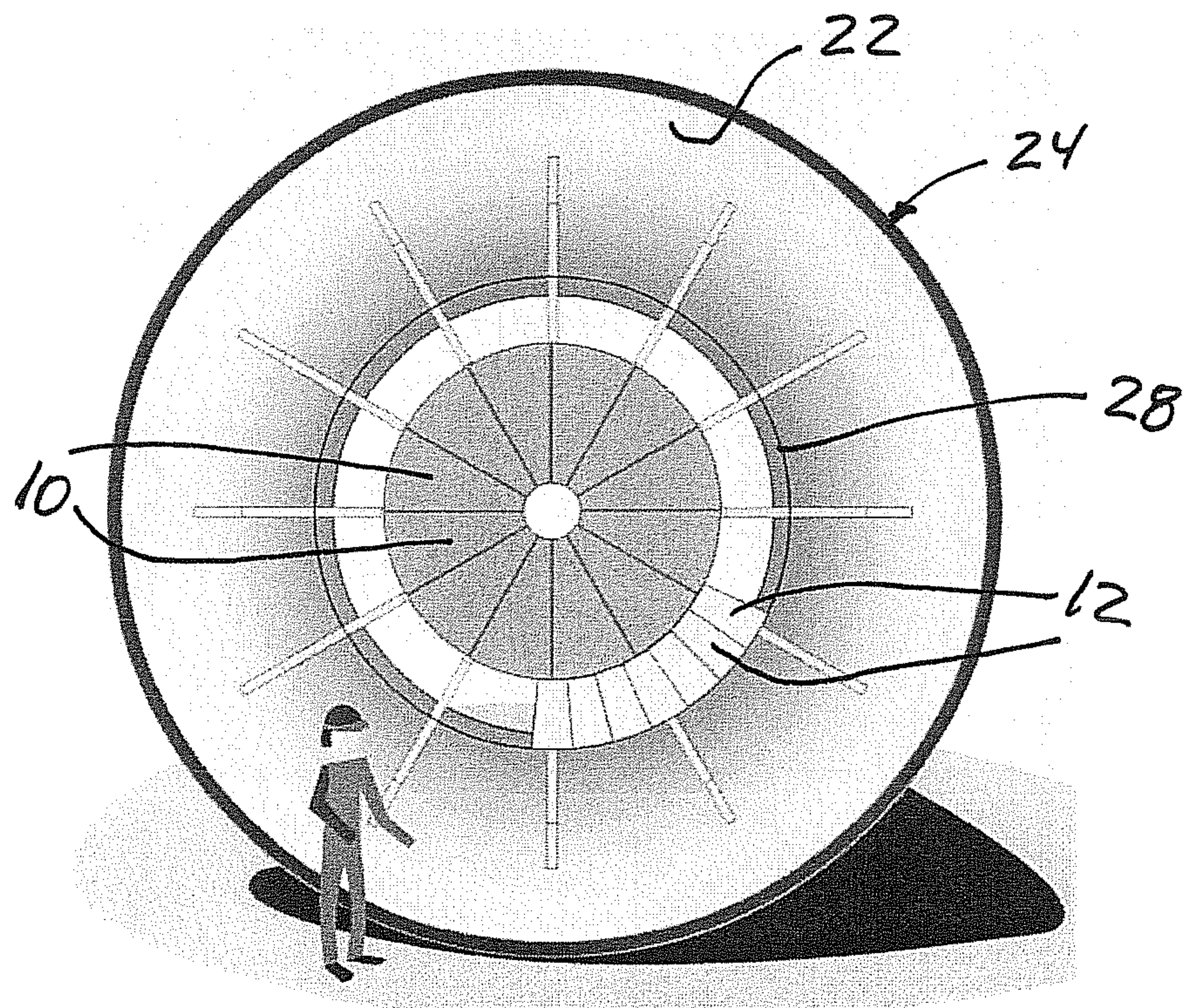


Fig. 22

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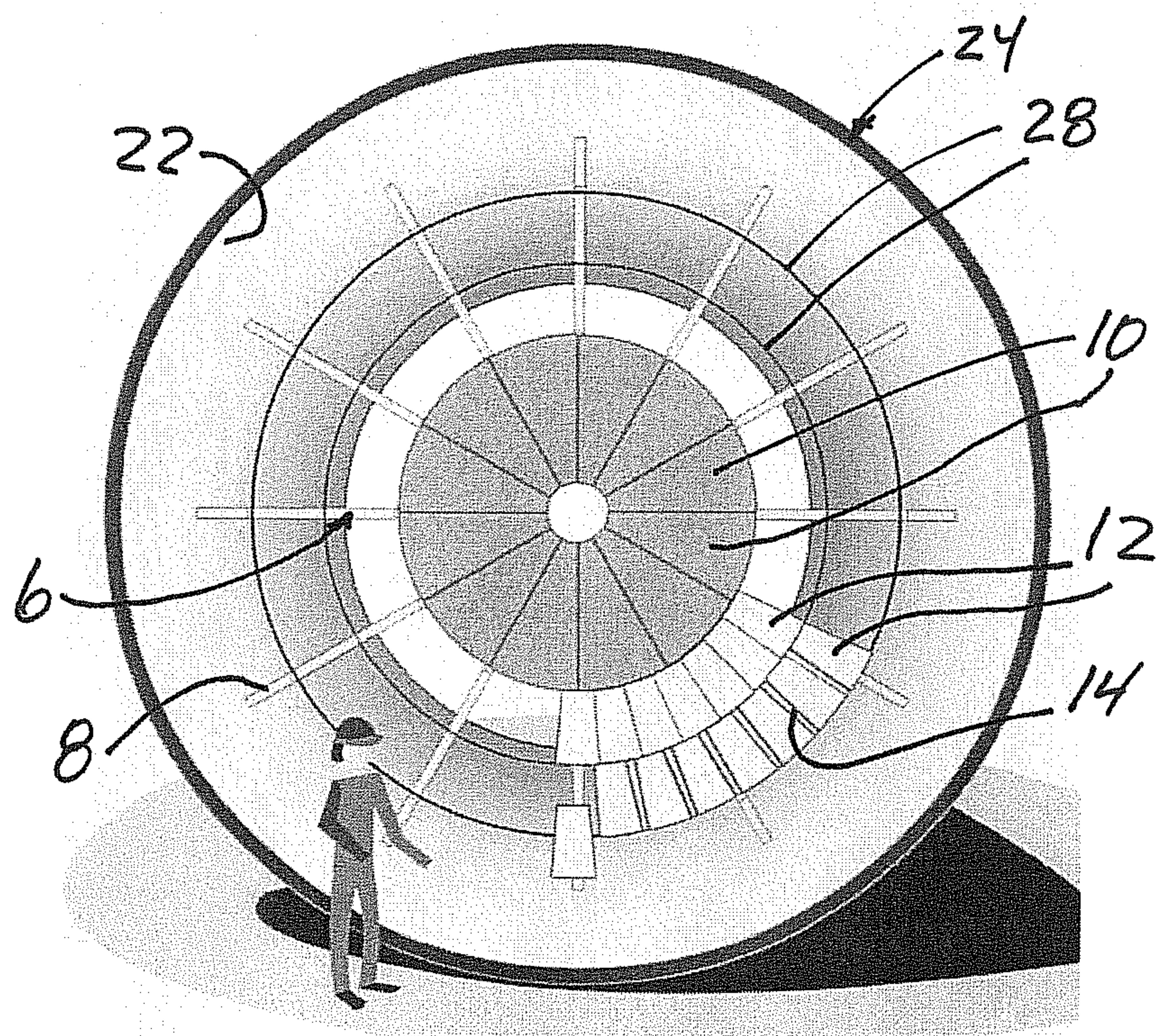


Fig. 23

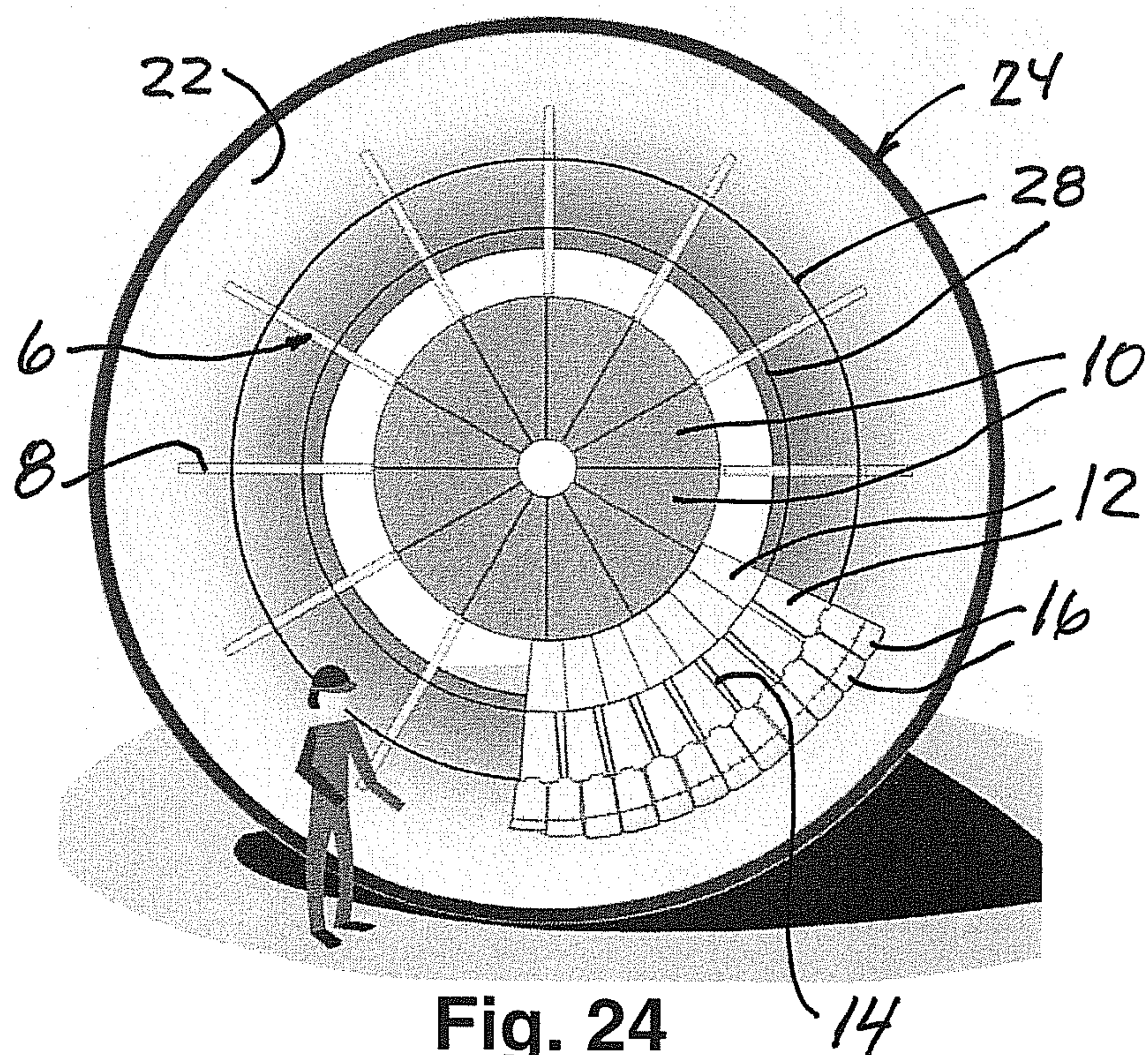


Fig. 24

13/13

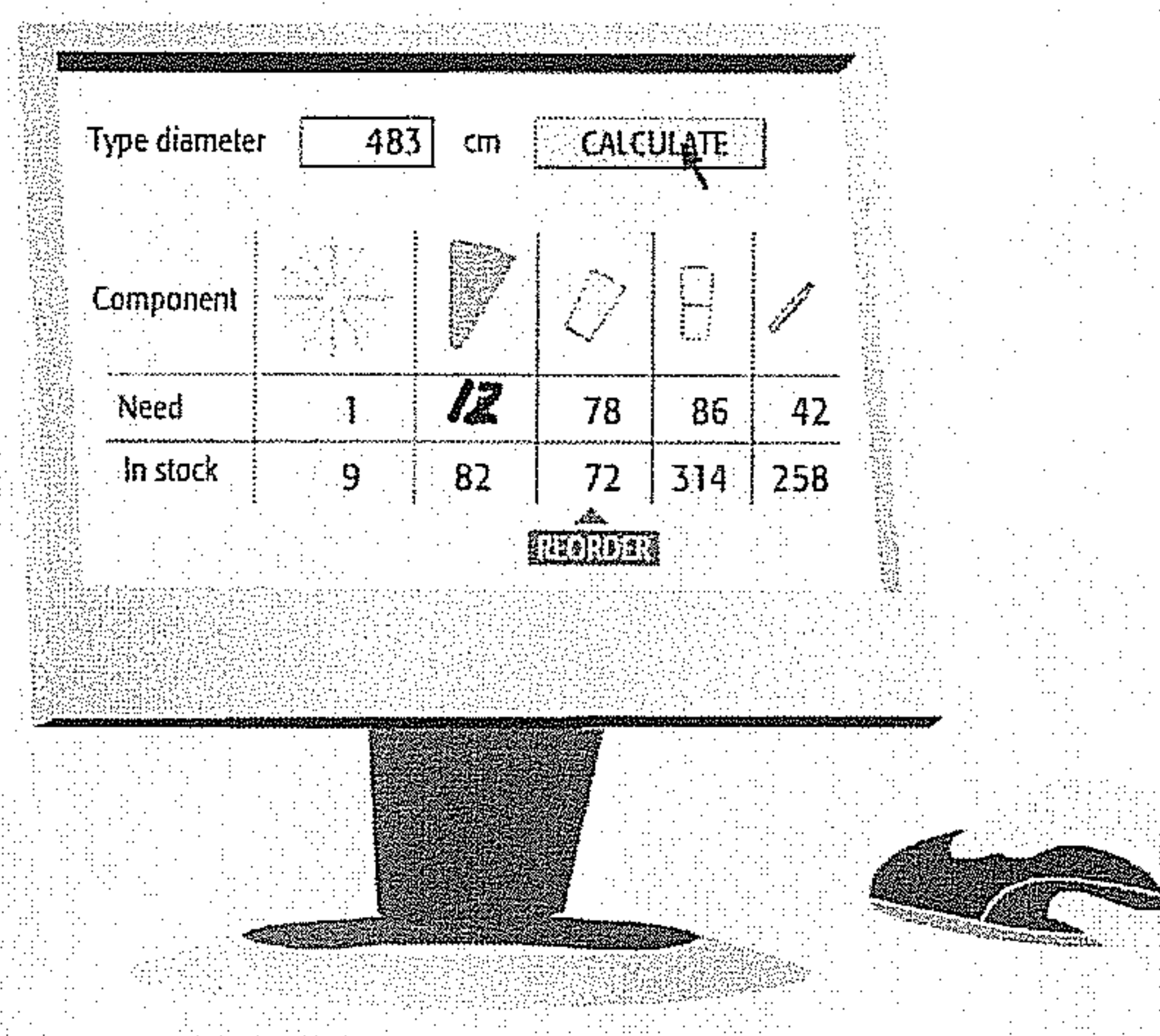


Fig.25

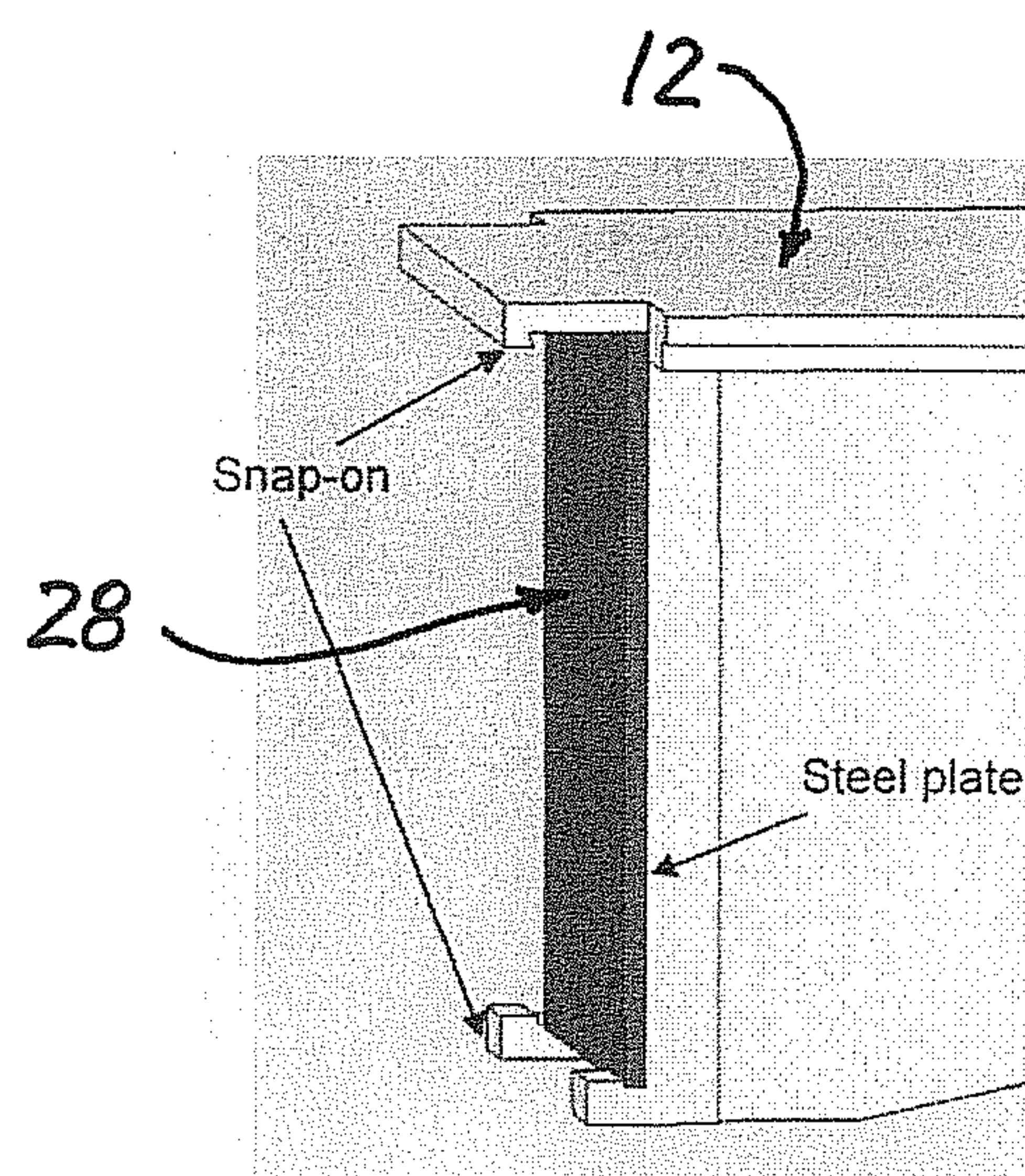


Fig. 26

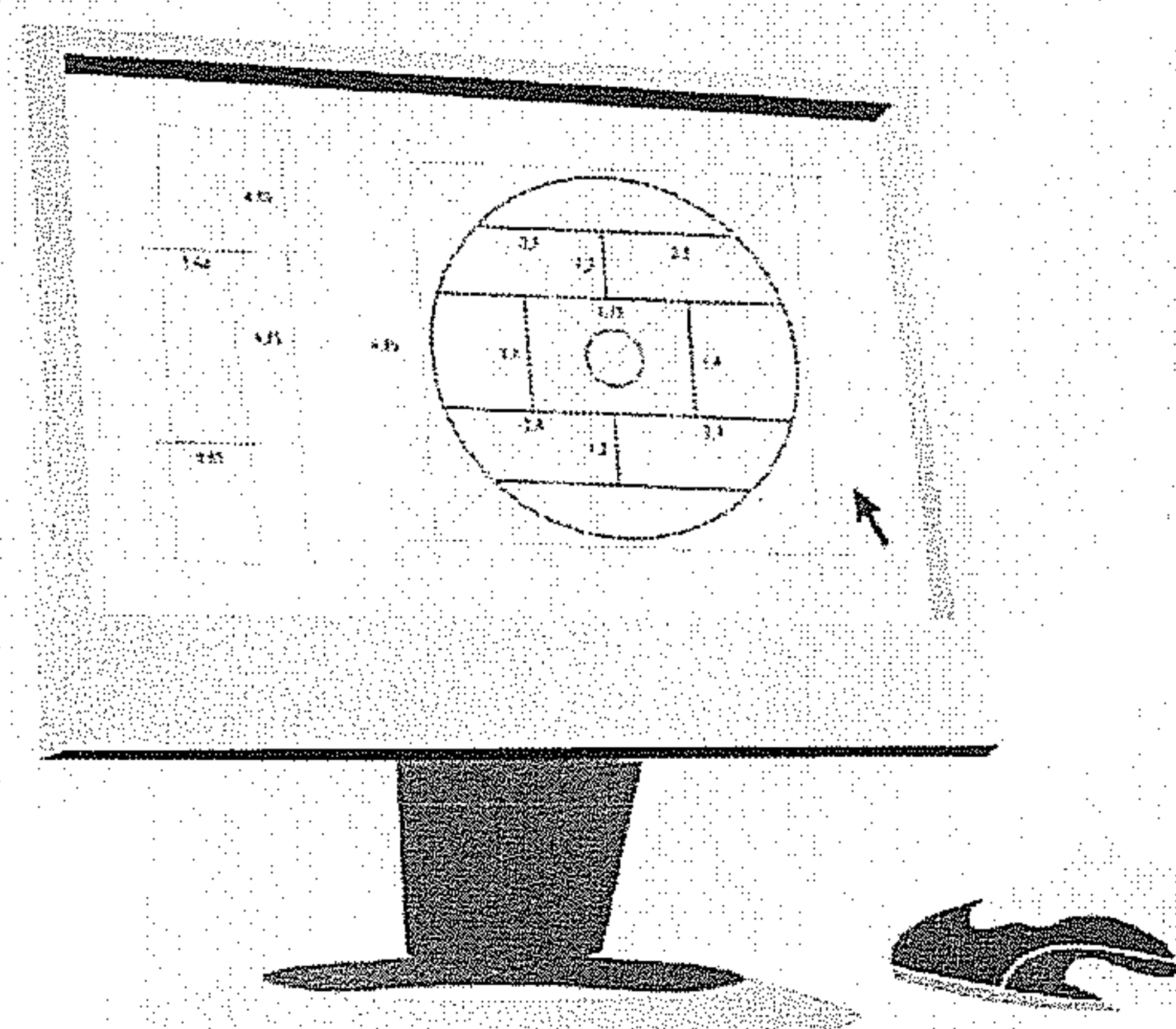


Fig. 27

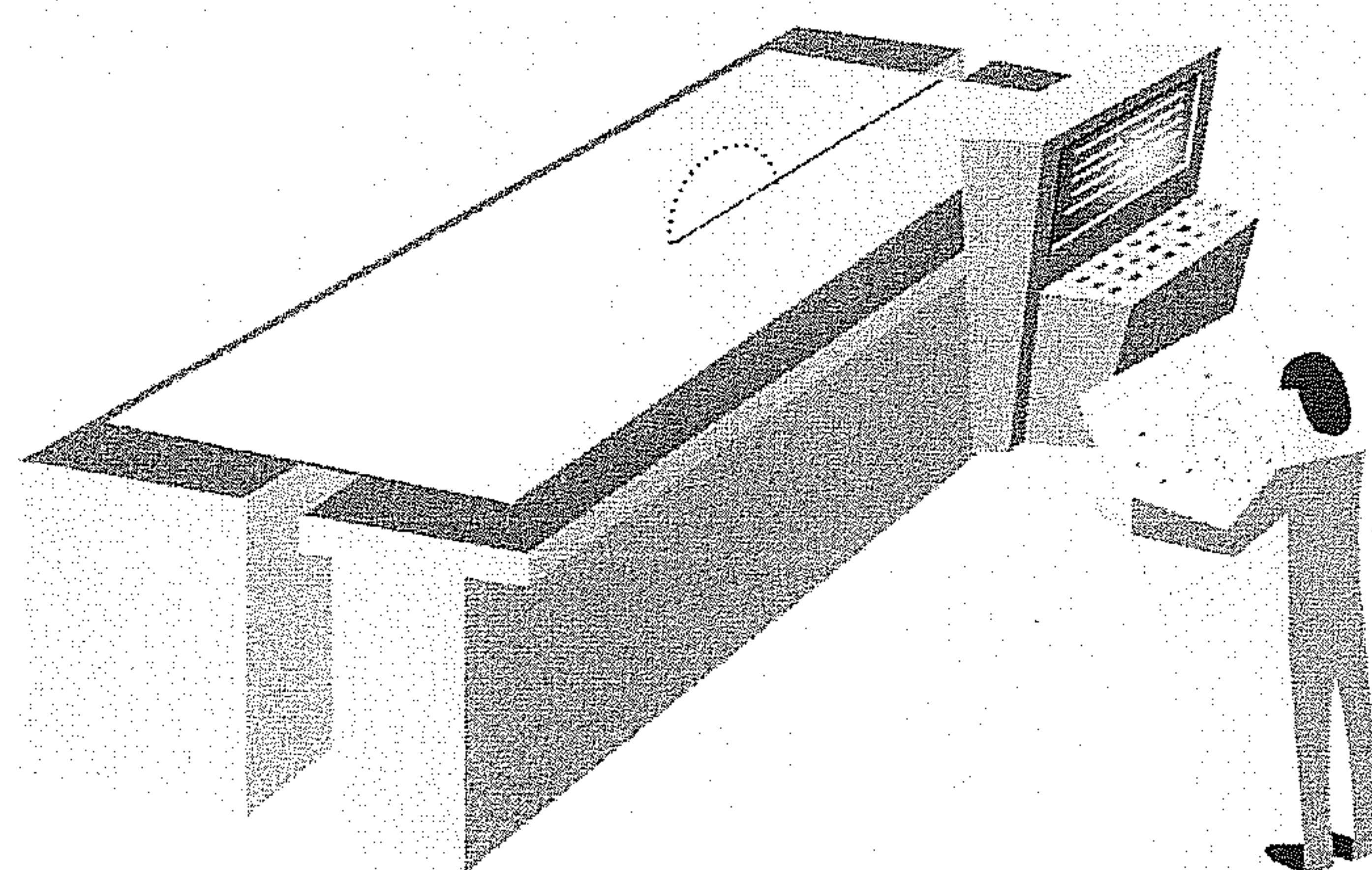


Fig. 28

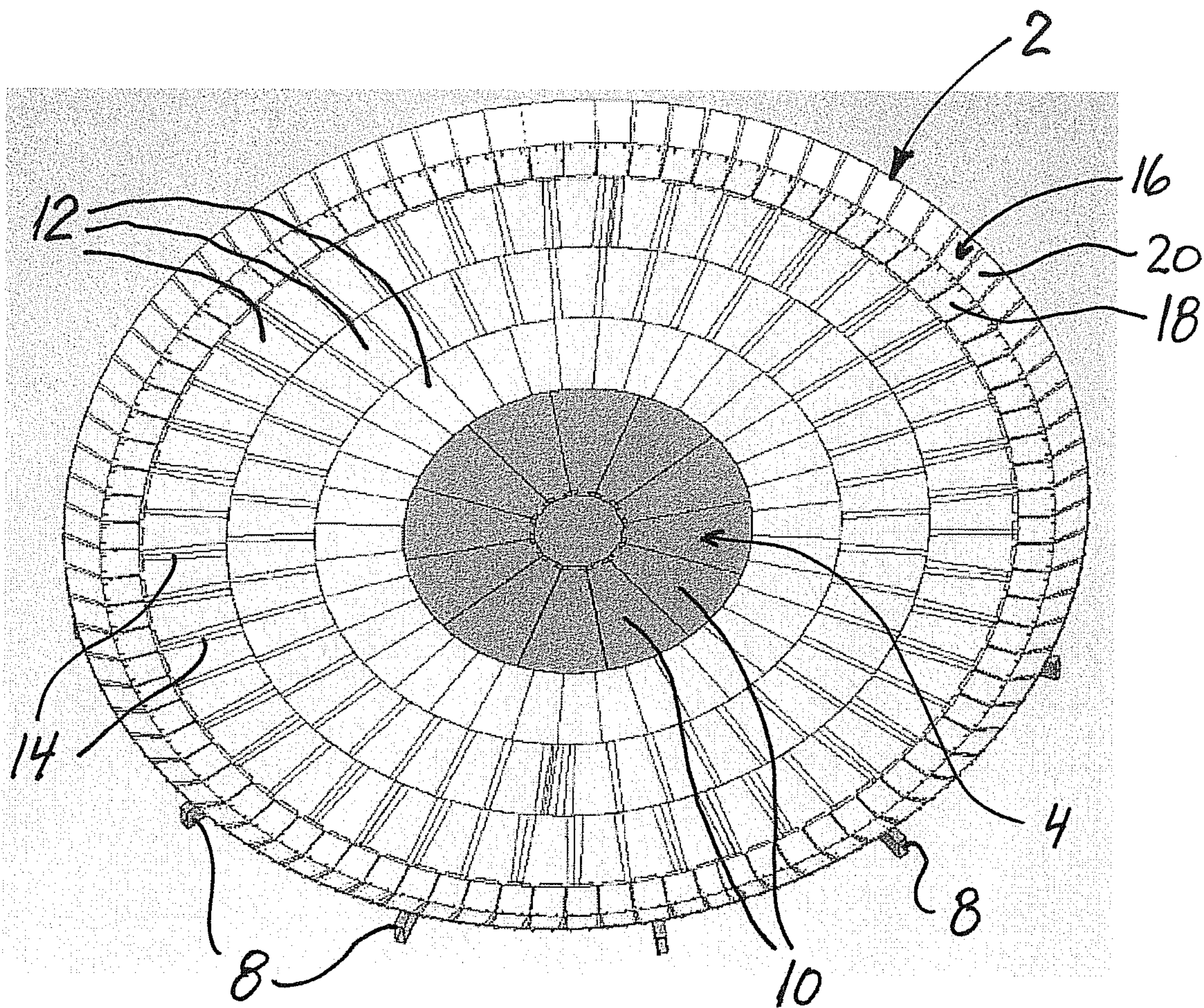


Fig. 2