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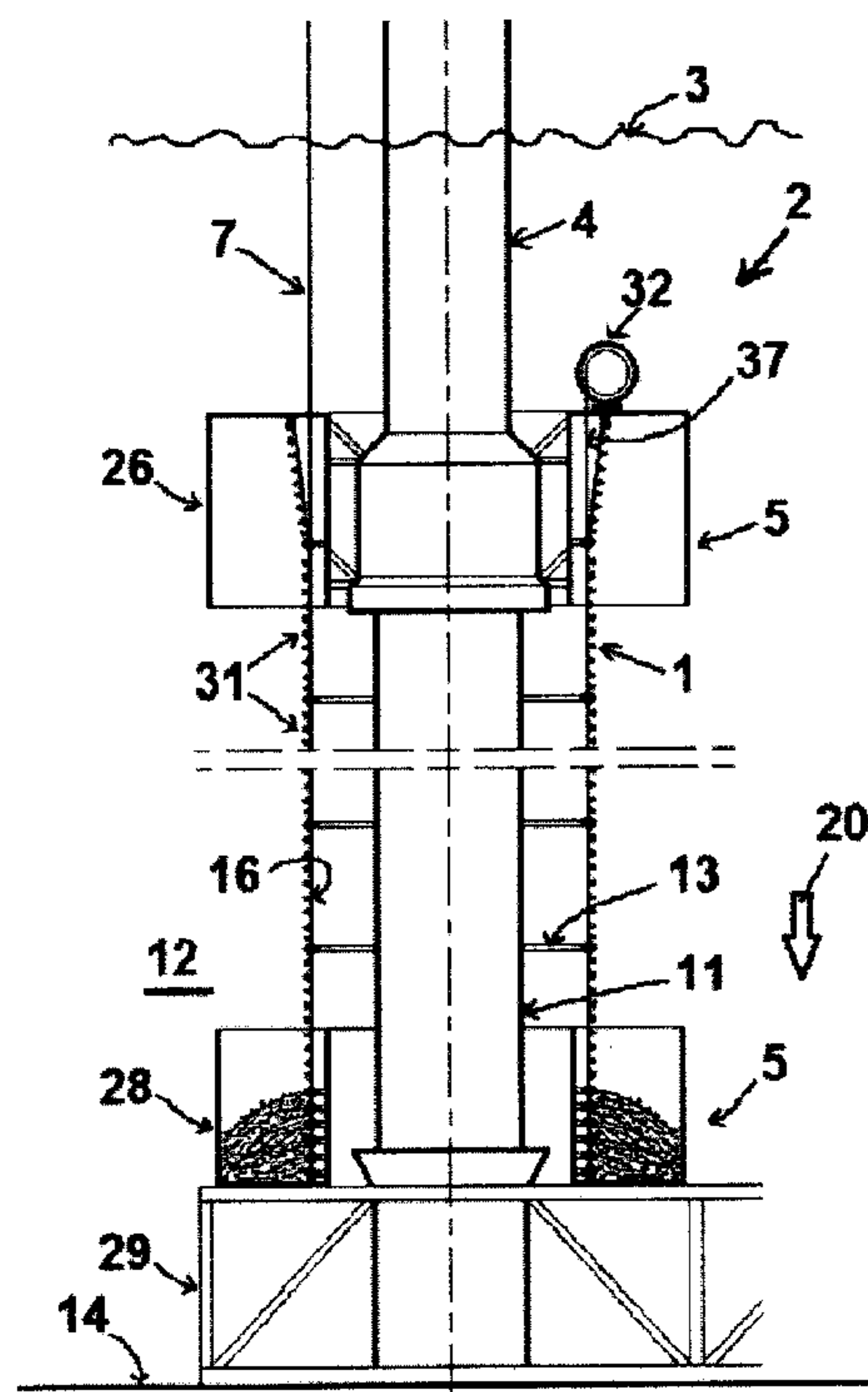
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(54) Titre : PROCEDE DE MANIPULATION D'UN AMORTISSEUR DE SONS EMIS SOUS L'EAU ET DISPOSITIF POUR REDUIRE LES SONS DANS L'EAU

(54) Title: METHOD FOR HANDLING A HYDRO SOUND DAMPER AND DEVICE FOR REDUCING UNDERWATER SOUND



(57) **Abrégé/Abstract:**

The invention relates to a method for handling a hydro sound damper (1) in the area of an offshore construction site, especially in the case of a pile to be introduced into the seabed (11), wherein, prior to the noise-emitting works, a hydro sound damper (1) is positioned in the region of the offshore construction site. The invention further relates to a device (2) for reducing underwater noise and for handling at least one hydro sound damper (1) in the region of an offshore construction site, especially in the case of a pile to be introduced into the seabed (11), the device (2) comprising at least one hydro sound damper (1) having a carrier structure (16) and noise-mitigating elements (31) fastened thereto.

Abstract

The invention relates to a method for handling a hydro sound damper (1) in the area of an offshore construction site, especially in the case of a pile to be introduced into the seabed (11), wherein, prior to the noise-emitting works, a hydro sound damper (1) is positioned in the region of the offshore construction site. The invention further relates to a device (2) for reducing underwater noise and for handling at least one hydro sound damper (1) in the region of an offshore construction site, especially in the case of a pile to be introduced into the seabed (11), the device (2) comprising at least one hydro sound damper (1) having a carrier structure (16) and noise-mitigating elements (31) fastened thereto.

Method For Handling A Hydro Sound Damper And Device For Reducing Underwater Sound

The invention relates to a method for handling a hydro sound damper in the area of an offshore construction site, in particular in the case of a pile to be inserted in the seabed, wherein prior to the noise-emitting operations a hydro sound damper is positioned in the area of the offshore construction site.

The invention also relates to a device for reducing underwater sound and/or for handling at least one hydro sound absorber in the area of the offshore construction site, in particular in the case of a pile to be inserted in the seabed, the device having at least one hydro sound damper.

Piles are inserted in the seabed with the aid of drills or pile drivers in order to serve there as foundations for marine structures, in particular, for offshore wind energy turbines. The foundations normally consist of one or multiple piles. A foundation having only one pile is referred to as single pile or monopole. A foundation that comprises multiple piles is often inserted in the ground using so-called templates. Such foundations are also called jacket foundations or tripod foundations.

In a tripod foundation, the structure is supported at the level of the seabed by a construction which includes three diagonal struts having additional horizontal braces. The latter are connected to piles inserted in the ground at the end of the struts facing the seabed.

In the jacket foundation, the structure is anchored on a truss structure called a jacket made of hollow piles. The truss structure is anchored to the piles inserted in the seabed. Normally, at least three piles are provided for a jacket foundation.

When using a tripod or a jacket, it has proven logistically advantageous if initially the piles are inserted in the seabed, for example, using a template, and the jacket or tripod is connected to the piles at a later point in time independently of the insertion of the piles.

During drilling and vibration pile driving in the seabed, in particular, during impulse pile driving of offshore piles, significant sound emissions are emitted from the piles inserted in the seabed, but also from the seabed. Such sound emissions may be harmful and life-threatening to fish and sea mammals living in the water. The sound originates at the frictional surface between piles and seabed and is transmitted by these into the surrounding water.

To solve this problem, a device is provided according to the invention for reducing waterborne sound and ground tremors in pile foundations in the water. Waterborne sound is also called hydro sound. To reduce the hydro sound, a hydro sound damper is known from the publication DE 10 2008 017 418 A1, referred to abbreviated as HSD. This damper consists of a plurality of damping elements spaced apart from one another for reducing the hydro sound, which are arranged evenly distributed on a carrier structure, for example, a net. The carrier structure is arranged at the operation site around a sound source. A sound source is a pile, for example, which is inserted in the seabed, which may be accomplished by means of pile driving or drilling.

The object of the invention is to provide an option in which the transport of a device for reducing hydro sound over land and sea to the operation site and the installation and recovery of such a device at the operation site may be carried out quickly, simply and

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cost-effectively, the device at the same time being suitable for maximum large-scale protection against hydro sound.

Thus, according to the invention, a method is provided, in which, to place the hydro sound damper in the area of the offshore construction site, a transport housing accommodating the hydro sound damper is positioned near the seabed or near the water surface, and subsequently, the hydro sound damper is spread from a first functional position out of the transport housing into a second functional position vertical, respectively, parallel to the extension of the pile, and/or horizontal, respectively, parallel to the geometry of the seabed. Since the hydro sound damper may be mechanically, hydraulically and/or pneumatically, preferably automatically spread to its required dimensions at the operation site with the aid of the device according to the invention, the placement of the hydro sound damper is possible with minimum expenditure of personnel and time. The same applies to the removal of the hydro sound damper from the operation site.

The device according to the invention is preferably equipped with a hydro sound damper, the carrier structure of which is a net and the sound mitigating elements of which for reducing hydro sound are suitable foam elements and/or air-filled envelope bodies.

Depending on the requirement of the hydro sound damper, for example, with respect to the water depth at the installation site, it is provided that the hydro sound damper is spread only partially or completely from the first functional position out of the transport housing. Thus, a device having a hydro sound damper for water depths of, for example, up to 30 meters may be deployed even in shallower waters, for example, at a water

depth of just 10 meters. The same applies to the horizontal positioning parallel to the seabed. The hydro sound damper is spread continually until it reaches an expanse required for reducing the sound. Moreover, an expansion need not be required according to the invention. This reduces the expenditure involved in erecting the construction site and the number of types of devices to be maintained. To reduce the propagation of sound, the hydro sound damper is placed around the pile over the entire length of the water column, i.e., from the seabed to the water surface.

Since the intensity of the sound in the ground decreases the more distant the sound source, it is advantageous to provide a device, by means of which the hydro sound damper may be placed parallel to the seabed, the hydro sound damper being spread from the sound source to a distance relevant for a sufficient reduction of the hydro sound. The required relevant distance is dependent, among other things, on the nature of the ground and on the work energy during insertion of the pile. Since the vibrations in the seabed and the sound in the water mutually influence each other, it is possible by placing the hydro sound damper parallel to the seabed on the one hand to minimize the sound in the water, and on the other hand to also reduce the vibrational excitation of the seabed caused by the hydro sound, and/or the propagation of tremors in the seabed.

It has also proven advantageous that upon conclusion of the noise-emitting operations, the hydro sound damper may be contracted from the second functional position and stored in the transport housing in the first functional position, the transport housing ultimately being removed from the offshore construction site. In this way, it is possible to remove the device simply and with little expenditure of time completely from the water. Since the device is returned to its compact structure advantageous for transport upon conclusion of the noise-emitting operations, the device is then immediately available for reuse at another construction site. The handling and storing on board a ship at least is possible without great effort.

Thus, according to the invention, a device is provided which comprises a holding means on which a first, fixed end of the hydro sound damper is held, and in which a second free end of the hydro sound damper remote from the first end of the hydro sound damper may be positioned movably, in particular, remotely relative to the holding means. This makes it possible to expand the hydro sound damper on site in a simple manner, even under the adverse conditions of an underwater construction site on the open seas, then to contract it again undamaged after use. This mobility according to the invention is the basis for a device, which on the one hand may be easily transported in a first functional position of the hydro sound damper, positioned at the construction site and removed from the construction site, and which also permits a large-scale and effective spread of the hydro sound damper.

According to one refinement of the invention, it is provided that the device includes at least one buoyancy body and/or one ballast body, the buoyancy body and/or the ballast body being connected to the second, free end of the hydro sound damper. The first and the second end of the hydro sound damper are designed to be movable relative to one another for unfolding and contracting the hydro sound damper. The ballast body, also called submersible body, is designed so that its specific weight is at least temporarily equal to or greater than the specific weight of the water surrounding the ballast body. The ballast body may be influenced, for example, by absorbing or discharging water or air and in this way alter its specific weight. The same applies to the buoyancy body. The buoyancy body is composed of one or multiple elastic chambers which are empty and/or filled with air and/or may be filled with water or, respectively, may be drained of these substances. The buoyancy body has a specific weight, which is equal to or less than the water surrounding the buoyancy body. The buoyancy body is used essentially to unfold the hydro sound damper against the force of gravity, whereas the unfolding of

the hydro sound damper with the force of gravity is achieved with the aid of the ballast body. Ballast body and buoyancy body act in opposite directions.

It is advantageous that the device includes a transport housing for storing and for transporting at least one hydro damper disposed in a contracted, first functional position, the transport housing being connected to the first, fixed end of the hydro sound damper and/or with the second, free end of the hydro sound damper. This makes it possible to first position the transport housing at the construction site and then just prior to sound generation to unfold the hydro sound damper from the transport housing. Until it is unfolded, the hydro sound damper may remain in the compact, contracted first functional position awaiting its use. Once the generation of sound is ended, the hydro sound damper is contracted again and stored in a space-saving manner in the transport housing. The compact transport housing is easy to handle.

For use in water, it has proven advantageous for the transport housing to be water-permeable, for example, to be designed as a basket. The transport housing may consist of one or multiple containers. In one embodiment, the transport housing consists of two baskets open on one side, with the open sides disposed one inside the other and opposite one another. In this arrangement, the hydro sound damper is situated in the one basket open at the top, and the second, somewhat larger, basket open at the bottom is disposed in the first functional position of the hydro sound damper above the smaller basket. Thus, the hydro sound damper in the first functional position is securely and captively enclosed by the transport housing. In the second functional position of the hydro sound damper, both baskets of the transport housing are disposed remote from one another, the hydro sound damper extending between the two baskets. According to one refinement of this embodiment, both baskets are ring-shape in design and provided for concentric mounting on the pile and/or around its insertion tool. Before producing the hydro sound damper, the smaller basket is initially held within the larger basket by a locking device. Once the transport housing is positioned in the water at the pile, the locking device may then be opened.

The first end is also referred to as the fixed end, since this end of the hydro sound damper is connected to a holding means, which is held stationary when the hydro sound damper is produced and retrieved. Conversely, the second end of the hydro sound damper as a free end is movable. The second end is connected to a ballast body and/or a submersible body for producing or retrieving the hydro sound damper.

The device, respectively, the hydro sound damper comprises alternatively or in addition to the ballast body numerous ballasting elements. These are connected to the carrier structure and counteract the buoyancy of the carrier structure and/or the buoyancy of the damping elements. The ballasting elements are adaptively dimensioned to the deployed depth in such a way that the weight thereof reduces the buoyancy force of the hydro sound dampers, or the weight thereof is significantly greater than the buoyancy force of the hydro sound damper. Thus, the ballasting elements are used as ballast bodies for lowering, in particular, the second end of the hydro sound damper. If the ballasting elements are distributed at least partially, in particular, uniformly over the hydro sound damper, the carrier structure and/or the net, then the tensile stress in the hydro sound dampers, the carrier structure and/or the net are significantly reduced as compared to the solutions known in the prior art.

In one embodiment variant of the device, the submerging of the second end of the carrier structure, respectively, the hydro sound damper, connected to the ballast body down to the seabed is ensured with the aid of the ballast body. The opposite first end of the hydro sound damper in this embodiment variant is retained by a holding means at or just above the surface of the water. The buoyancy of the hydro sound damper and/or the holding means on the one hand, and the weight of the ballast body and/or the sound mitigating elements on the other hand, causes a tightening and positioning of the preferably mesh carrier structure.

In a device in which the first, fixed end of the hydro sound damper is assigned to the surface of the water, the holding means is connected to an insertion tool, respectively, to the upper end of the pile. In a holding means connected to the insertion tool and/or to the pile, it is advantageous if these are positioned at the construction site together with the insertion tools, respectively, with the pile, in particular, may be raised from the pile and/or insertion tool from the ship with the aid of the hoist. This requires, as a result, less technical equipment to be maintained in readiness on the ship, and facilitates the positioning of the device on the pile. The hydro sound damper, before being produced, is maintained in the transport housing, in particular, with the aid of the locking device. Once the insertion tool is positioned on the pile in the water, the locking device may be opened and/or the hydro sound damper unfolded.

Alternatively, the holding means of the device is retained by a positioning means. The positioning means is independent of the hoist of the insertion tool. The hoist of the insertion tool and or of the pile comprises, for example, a crane carried on a ship having at least one winch and at least one cable connecting the winch to the pile and or to the insertion tool. The positioning means may, on the other hand, include a separate crane on the same or on a different ship. The positioning means according to one preferred embodiment comprises at least one winch independent of the hoist of the insertion tool and one cable independent of the hoist of the insertion tool, which connects the independent winch to the holding means. In another embodiment, the positioning means is a retaining means or a guide means for the pile, which is situated, for example, on the same ship as the hoist of the insertion tool, but is employed independently of the retaining or guide means.

The carrier structure is preferably a net on which a plurality of sound mitigating elements are preferably uniformly distributed. The sound mitigating elements of the hydro sound damper are spaced apart from one another. They are also referred to as damping bodies.

One refinement of the invention relates to a device having a cable which connects the first, fixed end to the second free end of the hydro sound damper. The hydro sound damper is freely movably attached to the cable, in particular in an at least partially expanded second functional position. The freedom of movement of the hydro sound damper along the cable relates, in particular, to central areas between the first and the second end. This design is employed preferably in an essentially vertically situated hydro sound damper, for example, in a hydro sound damper disposed around a pile. The carrier structure is connected to the cable by rings or loops. In order to counteract the buoyancy of the sound mitigating elements in the water, preferably ring-shaped ballasting elements are provided for connecting the carrier structure and the cable.

The hydro sound damper is also exposed to ocean currents. To prevent the latter from forcing the hydro sound damper against the pile, and while in abutment, damaging it or weakening its function, it has proven practical for the device to include spacers, which are disposed between the pile and the hydro sound damper and are connected to the hydro sound damper. The spacers are preferably implemented as a ring or ring segment. In this implementation, the spacers may at the same time appropriately serve as ballasting elements. For this purpose, the ballasting elements, respectively, the spacers may be slidably mounted for guidance on the cable.

In the above mentioned embodiment, the transport housing is mounted on an insertion tool and/or the pile. Another, alternative embodiment of the device provides that the transport housing is mounted on a template and/or a template is designed as a transport housing.

In this alternative embodiment of the device, the first, fixed end of the hydro sound damper is assigned to the seabed. The holding means in this case is connected to the template in such a way that the device, in particular, the hydro sound damper disposed in the first functional position is positioned together with the template at the construction site. Hence, the hydro sound damper may already be fastened to, or integrated in, the

template on land during construction of the latter, and is then towed with the template to the construction site. This reduces the assembly work at sea and simplifies the positioning of the hydro sound damper as compared to the solutions known in the prior art.

In a device in which the first end of the hydro sound damper is fastened to the template, it has proven practical to fasten the second end of the hydro sound damper to a buoyancy body. In the first functional position of the hydro sound damper, the buoyancy body is held on the transport housing. To unfold the hydro sound damper, the buoyancy body is released from the transport housing and/or filled with a gas, preferably with air. The buoyancy body then ascends and in the process pulls the hydro sound damper out of the transport housing and unfolds the hydro sound damper.

A further development of this device includes a capture device for receiving the buoyancy body. The capture device is disposed preferably in the area of the water surface. It may float on the water surface and/or may be held by a positioning means. The positioning means may be connected to a crane, to the pile or to the insertion tool. It is also possible to fasten the capture device directly to the pile or to the insertion tool.

The buoyancy body is preferably implemented as at least a hollow body, in particular as a tube. The hollow body may be a steel pipe, which may be filled with compressed air. However, the buoyancy body designed from a flexible tube has proven to be particularly simple and space-saving. According to a favored embodiment, the hollow body is ring-shaped in design, in particular surrounding the pile. The buoyancy body may also consist of multiple ring segments arranged next to one another surrounding the pile. The buoyancy body connected to the carrier structure of the hydro sound damper, when filled with air, ascends along the pile and in the process pulls the hydro sound damper upward. In this way, the hydro sound damper envelopes the pile from below up to the buoyancy body. The ascent of the buoyancy body and, therefore, the hydro sound

damper ends when the buoyancy body reaches the water surface or is received by the capture device.

The capture device may also be disposed below the water surface such that the buoyancy body travels along only a section of the water column. This implementation may be used in great depths. In this case, it is possible, for example, to provide two or multiple hydro sound dampers disposed one on top of the other. A first hydro sound damper, for example, may extend from the seabed up to the capture device and a second hydro sound damper may extend from the capture device up to the water surface. The vertical combination of multiple hydro sound dampers is, of course, also possible with the embodiment of the device in which a ballast body is attached to the second end of the hydro sound damper.

The embodiment of the device having a buoyancy body, which pulls the hydro sound damper out of the transport housing and unfolds it, is not necessarily limited to a template. It is also possible for a transport housing attached to a holding means, for example, to a monopile, to be lowered down to the seabed. For this purpose, the transport housing may be let down and held by a positioning means. A buoyancy body of the device is then activated, ascends guided by the cables of the positioning means and in the process unfolds the hydro sound damper.

This functionality is also possible without the buoyancy body, if the hydro sound damper itself has a sufficient buoyant force. In such case, a transport housing, preferably releasably fastened to a holding means of the device, would be lowered down by the positioning means on the pile. The first end of the hydro sound damper is connected to the holding means. The second end of the hydro sound damper is connected to a transport housing open on the bottom. If the transport housing is separated from the holding means, which functions as a ballast body and closure of the transport housing, the transport housing with the ascending hydro sound damper then ascends, the hydro sound damper being pulled downward out of the transport housing.

In the aforementioned embodiment, the ballast body may be lowered, or respectively, the buoyancy body may also be raised, in a controlled manner. For this purpose, it is provided that the device includes a pulling device for lowering and hauling up the second, free end of the hydro sound damper, the pulling device including a drive unit, in particular a cable winch, which is preferably mounted on the holding means, and a pulling means, preferably a cable, which is connected on the one hand to the drive unit and on the other hand to the second, free end of the hydro sound damper. Thus, it is possible, for example, with the aid of the one pulling device comprising an underwater winch, to hold the buoyancy body and, therefore, the hydro sound damper in the transport housing against the buoyant forces of the buoyancy body. Only by activating the pulling device does the buoyancy body ascend or is taken up again. The same applies to the reverse operating direction for a device having a ballast body.

It has proven advantageous for the cable and the nets of the device to be made of a textile material, for example, polyethylene fibers, in particular fibers made of ultra-high molecular polyethylene such as, for example, Dyneema.

In addition to the vertical spread of the hydro sound damper, i.e., oriented parallel to the extension of the pile, it is also advantageous to spread a hydro sound damper parallel, i.e. mainly horizontally, to the seabed. For this purpose, the device includes a spreading device, which is fastened to the holding means and/or to the template. The horizontal arrangement of the hydro sound damper contributes significantly to a reduction in the hydro sound. The sound emitted from the seabed into the water is reflected in part by the water masses and is reintroduced into the seabed. The sound reintroduced into the seabed is further conveyed by the seabed as ground tremors and is also emitted into the water again as sound. Thus, the sound propagates not just exclusively via the water or across the seabed, but rather also via the interaction between water and seabed. A hydro sound damper disposed parallel or horizontally to the seabed acts like a parallel damping layer. In addition to the sound emitted from the ground into the water, the

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intensity of the reflection of sound and, therefore, the subsequent reintroduction of the sound into the ground is reduced. This minimizes the hydro sound as a whole.

A spread of the hydro sound damper of 10 to 15 meters around the pile has proven sufficient in most applications.

- 5 A useful addition to the device, is that the device includes at least one decoupling means disposed on the underside of the holding means and/or the transport housing and/or the template, in particular between the seabed and the underside. In this way, it is possible to minimize the transmission of ground tremors to the parts of the device contacting the seabed, such that the emission of sound into the water is reduced by
- 10 these parts. The decoupling of the parts of the device contacting the seabed, in particular the heavier parts, such as the holding means, the ballast body or the template, reduces the interaction of the sound transmission between the seabed and the water and, therefore, the hydro sound. The elastic decoupling means consists preferably at least of a polymer and/or a spiral spring and/or a foam body and/or a
- 15 gas cushion.

In some embodiments, there is provided a method for handling a hydro sound absorber in the region of an offshore construction site, the method comprising: prior to beginning noise-emitting work, positioning, close to at least one of a seabed or a surface of the water, a transport housing storing a hydro sound absorber in a

20 contracted first functional position, the transport housing being permeable to water and the hydro sound absorber, which comprises a carrier structure and sound reduction elements fastened to the carrier structure, having a first end and a second end remote from the first end; spreading, at least one of vertically to the extent of the offshore construction site or horizontally to a geometry of the seabed, the hydro

25 sound absorber out from the contracted first functional position to an at least partially spread-out second functional position; and holding, by a holding mechanism, the first end of the hydro sound absorber while the second end of the hydro sound absorber is movable relative to the holding mechanism, wherein the sound reduction elements

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fastened to the carrier structure are spaced apart from one another in the at least partially spread-out second functional position, and wherein the transport housing is directly connected to at least one of the first end of the hydro sound absorber or the second end of the hydro sound absorber.

- 5 In some embodiments, there is provided a device for reducing water sound, the device comprising: a hydro sound absorber having a first end and a second end remote from the first end, the hydro sound absorber comprising: a carrier structure, and sound reduction elements fastened to the carrier structure; a holding mechanism, configured to hold a first end of the hydro sound absorber; and a transport housing
- 10 that is permeable to water and configured to store and transport the hydro sound absorber in a contracted first functional position, wherein the sound reduction elements fastened to the carrier structure are spaced apart from one another in an at least partially spread-out second functional position, wherein the second end of the hydro sound absorber is movable relative to the holding mechanism, and wherein the
- 15 transport housing is directly connected to at least one of the first end of the hydro sound absorber or the second end of the hydro sound absorber.

The invention allows for various embodiments. Some of these are shown in the drawing for further illustrating the basic principle of the invention and are described below. In the drawings:

- 20 Figure 1 shows in a schematic representation of a side view the basic functional principle of the invention having a hydro sound damper which, when spread, sinks to the seabed;

Figure 2 shows in a schematic representation of a side view the basic functional principle of the invention having a hydro sound damper which, when spread, rises to the water surface;

Figure 3 shows in a schematic representation a first arrangement of the invention with the device on a ship;

Figure 4 shows in a schematic representation a first arrangement of the invention with the device fastened to an insertion tool;

Figure 5 shows in a schematic representation a first arrangement of the invention with the device fastened to an insertion tool;

Figure 6 shows in a schematic representation a first arrangement of the invention with the device before the start of introducing a pile into the seabed, the hydro sound damper being in a first functional position;

Figure 7 shows in a schematic representation a first arrangement of the invention with the device when a pile is inserted in the seabed, the hydro sound damper being in a second functional position;

Figure 8 shows in a schematic representation a second arrangement of the invention with the device when a pile is inserted in the seabed, the hydro sound damper being in a first functional position;

Figure 9 shows in a schematic representation a third arrangement of the invention with the device;

Figure 10 shows in a schematic representation a third arrangement of the invention with the device;

Figure 11 shows in a schematic representation a fourth arrangement of the invention with the device before a insertion tool is placed on a pile;

Figure 12 shows in a schematic representation a fourth arrangement of the invention with the device before a pile is inserted in the seabed;

Figure 13 shows in a schematic representation a fourth arrangement of the invention with the device as a pile is inserted in the seabed;

Figure 14 shows in a schematic representation a fifth arrangement of the invention with the device as the hydro sound damper is spread;

Figure 15 shows in a schematic representation a fifth arrangement of the invention with the spread hydro sound damper;

Figure 16 shows in a schematic representation various embodiments of the fourth arrangement of the invention;

Figure 17 shows in a schematic representation embodiments of the fourth arrangement of the invention;

Figure 18 shows in a schematic representation a top view of a template;

Figure 19 shows in a schematic representation a side view of a template;

Figure 20 shows in a schematic representation a sixth arrangement of the invention having a first variant of a hydro sound damper spread parallel to the seabed;

Figure 21 shows in a schematic representation a sixth arrangement of the invention having a second variant of a hydro sound damper spread parallel to the seabed;

Figure 22 shows in a schematic representation another arrangement of the invention having a hydro sound damper spread parallel to the seabed;

Figure 23 shows in a schematic representation another arrangement of the invention having a hydro sound damper spread parallel to the seabed;

Figure 24 shows in a schematic representation another arrangement of the invention having a hydro sound damper spread parallel to the seabed;

Figure 25 shows in a schematic representation another arrangement of the invention having a decoupling means;

Figure 26 shows in a schematic representation another arrangement of the invention having a hydro sound damper spread parallel to the seabed;

During underwater operations, in particular, when inserting a pile 11 in the seabed 14, the sound generated is radiated by the pile 11 into the water 12 surrounding it. Sound is also radiated into the water 12 by the tremors in the seabed 14. To reduce the hydro sound, i.e., the sound in the water, a device 2 is provided, several embodiments of which are described in greater detail below. The method according to the invention is also described in conjunction with the exemplary embodiments of the device 2 shown in the figures.

The method is used for handling a hydro sound damper 1 in the area of an offshore construction site, in particular, in conjunction with a pile 11 being inserted in the seabed. The hydro sound damper 1 must be positioned in the area of the offshore construction site before the sound-emitting operations at the offshore construction site begin. To

place the hydro sound damper 1, a transport housing 5 is positioned near the seabed 14 or near the water surface 3. The hydro sound damper 1 is stored and transported in the transport housing 5 in a first functional position. Once the transport housing 5 is positioned as provided, the hydro sound damper 1 is spread from the first functional position out of the transport housing 5 into a second functional position vertical, parallel to the extension of the pile 11 and/or horizontal, parallel to the geometry of the seabed 14. Upon conclusion of the sound-emitting operations at the offshore construction site, the hydro sound damper 1 is contracted from the second functional position and stored in the transport housing 5 in the first functional position. Lastly, the transport housing 5 is removed from the offshore construction site.

The basic functional principle of the invention is shown in Figures 1 and 2. The device 2 comprises a hydro sound damper 1, the ends of which, being opposite and assigned to the water surface 3 and, respectively, the seabed 14, are connected to at least one buoyancy body 17 and/or at least one ballast body 13. In this arrangement, the end of the hydro sound damper 1 assigned to the water surface 3 is connected to a float device 9 or a buoyancy body 17, whereas the opposite end of the hydro sound damper 1 facing the seabed 14 is connected to a ballast body 13. The ends of the hydro sound damper 1 may be moved relative to one another by optionally filling the buoyancy body 17 and/or ballast body 13 with gas and/or water, and respectively, with the aid of the positioning means 7 shown in Figure 3 and/or the pulling device 32 shown in Figure 11. The hydro sound damper 1 spreads when the distance between the ends increases. When the distance decreases, the hydro sound damper 1 is folded together.

Figure 1 shows an example, in which a ballast body 13 is lowered 20 by a float device 9 in the direction of the seabed 14. In the process, the hydro sound damper 1 is spread. For example, ballasting elements 13 may be lowered 20 with the aid of a pulling device 32 not depicted here, and may ascend 21 with the aid of the latter and/or regulated buoyancy bodies 17, which are filled with air if needed.

Figure 2 shows a device 2, in which the hydro sound damper 1 has buoyancy bodies 17 at one end, which ascend 21 in order to spread the hydro sound damper 1 from the seabed up. The other end of the hydro sound damper 1 is fastened to a ballast body 13.

The ballast bodies 13 and the buoyancy bodies 17 are composed of chambers for lowering 20 and raising 21, in which water and/or gas, preferably air, is filled or removed when needed. The lowering 20 of the hydro sound damper 1 allows for intermittent ship traffic over the hydro sound damper 1, for example, in the case of longer work stoppage. Chambers used as ballast bodies 13 and/or buoyancy bodies 17 are also fastened in one embodiment variant between both ends, in particular, uniformly distributed on the carrier structure 16.

In a first arrangement of the invention depicted in Figures 3 through 7, a device 2 is provided in which the transport housing 5, together with the folded hydro sound damper 1 is held by a crane 18. The crane 18, as part of a positioning means 7, also called a lifting device, of the hydro sound damper 1 is mounted on a ship 23. In the first arrangement depicted, the crane 18 is also part of a hoist 6 of a insertion tool 4. The insertion tool 4, for example, a pile driver, is used to insert the pile 11 in the seabed 14.

The positioning means 7 raises the transport housing 5. Here, the transport housing 5 is situated around the insertion tool 4, which is held by a cable of the hoist 6. The positioning means 7 and the hoist 6 are independent of one another. They comprise separate cables and winches independent of one another. To maintain a distance from the insertion tool 4, the positioning means 7 includes a cross member 8. As an alternative to the cross member 8, the positioning means 7 may also include multiple cables. The transport housing 5 is fastened to the cross member 8 with the aid of at least three, still better, four cables.

Prior to insertion of the pile 11, the transport housing 5 is positioned near, in particular, above the head 10 of the pile 11, but at least at or above the water surface 3. During

insertion of the pile 11 into the seabed 14, the head 10 may be above or also below the water surface 3. During the pile driving operation, the transport housing 5 is held in its position or is lowered to the water surface 3. A float device 9 depicted in Figure 8 may be attached to the transport housing 5 for floating on the water surface 3.

Prior to initiating insertion of the pile 11 in the seabed 14 and or inserting the holding means 15, a ballast body 13 is lowered to the seabed 14 with the aid of a pulling device 32. Using the ballast body 13, the carrier structure 16 of the hydro sound damper 1 is spread from the transport housing 5 along the pile 11 down to the seabed 14. The carrier structure 16 of the hydro sound damper 1 is movably mounted at regular intervals on the tensioned cables 37.

After insertion of the pile 11, the hydro sound damper 1 is recovered. For recovery, the ballast body 13 is pulled up again to the transport housing 5, whereby the hydro sound damper 1 is arranged in the transport housing 5.

Figure 8 shows a second arrangement of the invention, in which the device 2 is equipped with a float device 9. The float device 9 is connected to the transport housing 5. The transport housing 5 was positioned by using a positioning means 7 as shown in Figures 4 and 5. Once the transport housing 5 is floating on the water surface 3, the positioning means 7 is no longer required, and may be released from the transport housing 5. The transport housing 5, since it surrounds the pile 11, is unable to drift away. The lowering of ballast bodies 13 and the hydro sound damper 1 prior to initiation of insertion, and the recovery of the hydro sound damper 1 are carried out as described above with the aid of a pulling device 32 attached to the transport housing 5.

The Figures 9 and 10 show a third arrangement of the invention. In this device 2, the carrier structure 16 of the hydro sound damper 1 is connected to a buoyancy body 17 and a ballasting elements 13. The buoyancy body 17 and/or the ballast body 13 each consist of a tube 22 to which the carrier structure 16 of the hydro sound damper 1 and

weights 19 as additional ballast bodies 13 are fastened. For ascending 21, the tube 22 is filled with air. For lowering 21 the air is drained from the tube 22 and/or the tube 22 is filled with water.

The use of a tube 22 has the advantage that the hydro sound damper 1 may be positioned flush to the contour of the seabed 14. In this case, the ballasting elements 13 is attached to obstacles 24 such as, for example, rocks. The partial lowering, as depicted in Figure 9 or completely lowering 20 of the buoyancy body 17 makes it possible to at least temporarily allow ship traffic 25 to cross when a hydro sound damper 1 is spread.

The weights 19 and the water-filled tube 22 of the ballasting elements 13 rest against the seabed 14. In the case of a sensitive seabed 14, for example, in the case of mussel beds, the tube 22 may also be filled with just enough air and/or water, so that the ballasting elements 13 hovers only a few decimeters above the seabed 14, and thus, in the event of currents, does not drag along the latter. The weights 19 may be a chain, for example.

The Figures 11 through 13 show a fourth arrangement of the invention. The device 2 according to the invention is fastened to the insertion tool 4 and comprises a transport housing 5, in which the hydro sound damper 1 is disposed, in particular, for transport to and from the operation site. The insertion tool 4 is suspended on a hoist 6. The transport housing 5 is arranged around the insertion tool 4 and consists of two telescoped, ring-shaped baskets 26, 28. The smaller, inside basket 28 contains the hydro sound damper 1. The larger, outer basket 26 is open at the bottom and fastened with the aid of the holding means 15 to the insertion tool 4, a hydraulic pile driver. The hydro sound damper 1 comprises at least one net as carrier structure 16, on which a plurality of sound mitigating elements 31 for reducing the hydro sound is arranged

The upper end of the carrier structure 16 is fastened to the larger basket 26. The smaller basket 28 is connected to a positioning means 7 or to a pulling device 32. Alternatively, the larger basket 26, similar to the arrangement of Figures 3 through 7, is held with the aid of the positioning means 7, the smaller basket 28 then being connected to a pulling device 32 or to a second hoist for lowering 20. The larger basket 36 may then be fastened with the aid of the holding means 15, but also to a pile guide situated near the water surface, or to the installation vessel. The pulling device 32 is preferably an electric or hydraulic underwater winch.

Before producing the hydro sound damper 1, the first basket 28 is held initially in the second basket 26 by a locking device. Once the insertion tool 4 is positioned on the pile 11 in the water 12, the locking device may then be opened.

Figure 12 depicts how the pile 11 is supported and guided by a template 29 positioned on the seabed 14. The insertion tool 4 may be placed on the pile 11 both above the water surface 3, as depicted in Figure 12, as well as below the water surface 3, as depicted in Figure 13.

To produce the hydro sound damper 1, the first basket 28 is lowered down to the seabed 14 or to the template 29 by activating the positioning means 7 or the pulling device 32. In the process, the pile 11 is fully enveloped by the hydro sound damper 1, as indicated in Figure 13.

Ring-shaped ballasting elements 13 are fastened to the carrier structure 16 in order to counteract the buoyancy of the sound mitigating elements 31 in the water 12. The ballasting elements 13 pull the hydro sound damper with the first basket 28 downward, and simultaneously acts as a spacer for the pile 11. The ballasting elements 13 are mounted for guidance on the cables 37 of the positioning means 7 or the pulling device 32.

Figures 14 and 15 shows a fifth arrangement of the invention. The device 2 according to the invention has a transport housing 5, which includes a ring-shaped basket 28 open at the top, in which the hydro sound damper 1 is received. The basket 28 may be lowered down to the seabed 14 or is fastened to a template 29 positioned on the seabed 14. The weight of the above described ballasting elements 13, the spacer means, the carrier structure 16 and/or a locking device not depicted, or a pulling device 32 hold the hydro sound damper 1 in the basket 28.

The device 2 comprises a ring-shaped buoyancy body 17, which is attached to the carrier structure 16 of the hydro sound damper 1. The buoyancy body 17 is a ring-shaped, continuous tube or is composed of multiple individual segments. When filled with air, the buoyancy body 17 rises to the water surface 3. The buoyancy body 17 may be filled with air just for ascending 21 or may be continuously filled with air. Preferably, the buoyancy body 17 is held by a locking device to the transport housing 5. The ascending 21 buoyancy body 17 pulls the hydro sound damper 1 upward along the pile 11. The hydro sound damper 1 envelops the pile 11 from below up to the buoyancy body 17. The ascent 21 of the buoyancy body 17 and, therefore, the hydro sound damper 1 ends when the buoyancy body 17 reaches the water surface 3 or is received by a capture device 35 of the device 2. The capture device 35 is preferably fastened to the insertion tool 4.

By releasing the air charge in the buoyancy body 17, the hydro sound damper 1 may be lowered again incrementally. Additional, separate cables are not required in this embodiment variant. Depicted in the right hand portion of Figures 14 and 15, respectively, is a variant having at least one additional pulling device 32 for cable tensioning. With the pulling device 32 implemented as an underwater winch, it is possible to hold the hydro sound damper 1 in the basket 28 against the buoyancy of the buoyancy body 17 filled with air, to allow the hydro sound damper 1 to ascend 21 from the basket 28 and to lower it again 20. The carrier structure 16 of the hydro sound damper 1 may be movably mounted on the cables 37 between the buoyancy body 17

and the pulling device 32. The cables 37, in addition to the carrier structure 16, may also be used for guiding the ballasting element 13 and the spacer means.

The embodiments explained in Figures 11 through 15 are not limited to the use with a template 29. Figures 16 and 17 show the embodiments in conjunction with a monopile. Figure 18 and 19 shows a template 29 in a sectional top view and a side view with no hydro sound damper.

When inserting a pile 11 into the seabed 14, the sound generated is radiated not only from the pile 11 into the water 12 surrounding it. Sound is also radiated into the water 12 as a result of the tremors in the seabed 14. Embodiment variants of another arrangement of the invention for reducing the hydro sound, that is, the sound in the water 12, are depicted in Figures 20 through 26. These embodiment variants serve to reduce the hydro sound generated by the interaction of water 12 and seabed 14.

Figures 20 and 21 show a sixth arrangement of the invention. The device 2 has a hydro sound damper 1, which is spread parallel to the seabed 14. To spread and retrieve the hydro sound damper, the carrier structure 16 is extended by means of a spreading mechanism 36, for example, a scissor device 27. The spreading mechanism 36 may be pneumatically and/or hydraulically operated. For raising and lowering, the device 2 has ballast bodies 13 fillable with water and/or air, or buoyancy bodies 17. The spreading mechanism 36, together with the carrier structure 16 as depicted, is fastened to a template 29. The hydro sound damper 1 on the seabed 14 preferably has a round cross-section. In a template 29 for multiple piles 11, the cross-section may also be angular. In addition, the template 29 may also be covered with a hydro sound damper 1.

Figures 22 through 26 show that hydro sound dampers 1 are disposed in the area of the pile 11 and, in particular, on all other constructions and devices on the seabed 14, such as a template 29 shown in Figures 18 and 19. The upper side as well as the lower side and the interior of the template 29 are sound-reducingly enveloped by the meshed

hydro sound damper 1. The seabed 14 may be effectively covered by fold-out 34 or slide-out 33 spreading mechanisms 36 disposed on the sides of the template 29. The spreading mechanisms 36, also called panel elements, are covered by hydro sound dampers 1. Alternatively, hydro sound dampers 1, as shown in Figure 24, may be expanded, in particular, around the piles 11, with the aid of horizontal and/or vertical scissor devices 27. The scissor devices 27, or spreading mechanisms 36, are preferably disposed on the sides of the template 29.

Figures 17 and 25 show another arrangement of the invention. The device 2 in this refinement of the invention has multiple decoupling means 30 on the basket 28, on the ballast body 13, respectively, on the holding means 15 and/or on the template 29. The decoupling means 30 are arranged between the underside of the basket 28 and the seabed 14, or respectively, between the underside of the template 29 and the seabed 14. The decoupling means 30 shield the basket 28, or respectively, the template 29 from ground tremors. For this purpose, the decoupling means 30 comprise springs, damping elements and/or air-filled envelope bodies. The decoupling means 30 reduce the transmission of oscillations, vibrations or ground tremors to the device 2 and/or the template 29, and with that, the further transmission to the water 12 and the generation of hydro sound.

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CLAIMS:

1. A method for handling a hydro sound absorber in the region of an offshore construction site, the method comprising:

prior to beginning noise-emitting work,

5 positioning, close to at least one of a seabed or a surface of the water, a transport housing storing a hydro sound absorber in a contracted first functional position, the transport housing being permeable to water and the hydro sound absorber, which comprises a carrier structure and sound reduction elements fastened to the carrier structure, having a first end and a second end remote from the first end;

10 spreading, at least one of vertically to the extent of the offshore construction site or horizontally to a geometry of the seabed, the hydro sound absorber out from the contracted first functional position to an at least partially spread-out second functional position; and

holding, by a holding mechanism, the first end of the hydro sound
15 absorber while the second end of the hydro sound absorber is movable relative to the holding mechanism,

wherein the sound reduction elements fastened to the carrier structure are spaced apart from one another in the at least partially spread-out second functional position, and

20 wherein the transport housing is directly connected to at least one of the first end of the hydro sound absorber or the second end of the hydro sound absorber.

2. The method for handling a hydro sound absorber according to claim 1, wherein after completion of the noise-emitting work, the hydro sound absorber is contracted from a second functional position and is placed in the transport housing in

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the first functional position, and the transport housing is removed from the offshore construction site.

3. The method according to claim 1, wherein the offshore construction site is a case of a pile to be introduced into the seabed.

5 4. A device for reducing water sound, the device comprising:

a hydro sound absorber having a first end and a second end remote from the first end, the hydro sound absorber comprising:

a carrier structure, and

sound reduction elements fastened to the carrier structure;

10 a holding mechanism, configured to hold a first end of the hydro sound absorber; and

a transport housing that is permeable to water and configured to store and transport the hydro sound absorber in a contracted first functional position,

15 wherein the sound reduction elements fastened to the carrier structure are spaced apart from one another in an at least partially spread-out second functional position,

wherein the second end of the hydro sound absorber is movable relative to the holding mechanism, and

20 wherein the transport housing is directly connected to at least one of the first end of the hydro sound absorber or the second end of the hydro sound absorber.

5. The device according to claim 4, wherein the device has at least one of at least one buoyancy body or a ballast body connected at least to the second end of the hydro sound absorber.

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6. The device according to claim 5, wherein the device has a buoyancy body connected to the second end of the hydro sound absorber, the device further comprising a collecting device for receiving the buoyancy body of the device.

7. The device according to claim 6, wherein the collecting device is
5 arranged in the region of a surface of the water.

8. The device according to claim 4, further comprising a cable, which connects the first end to the second end of the hydro sound absorber and on which the hydro sound absorber is freely movably arranged.

9. The device according to claim 8, wherein the hydro sound absorber is in
10 an at least partially spread-out second functional position.

10. The device according to claim 4, wherein the transport housing is arranged on at least one of a template or an introduction tool.

11. The device according to claim 10, further comprising a spreading mechanism fastened to at least one of the holding mechanism or the template and
15 via which the hydro sound absorber is spread out horizontally along the seabed.

12. The device according to claim 4, wherein the first end of the hydro sound absorber is associated with a surface of the water,

wherein the holding mechanism is at least one of connected to an introduction tool or held by a positioning mechanism of the device independently of a
20 hoist of an introduction tool.

13. The device according to claim 4, wherein the first end of the hydro sound absorber is associated with a seabed, and

wherein the holding mechanism is connected to a template.

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14. The device according to claim 4, further comprising a pulling device configured to at least one of lower or haul up the second end of the hydro sound absorber, the pulling device including a drive assembly and a pulling means connected to the drive assembly and to the second end of the hydro sound absorber.

5 15. The device according to claim 14, wherein the drive assembly is disposed on the holding mechanism.

16. The device according to claim 4, further comprising at least one decoupling mechanism disposed on at least one of the holding mechanism or a transport housing or a ballast body or a template.

10 17. The device according to claim 4, wherein the offshore construction site is a case of a pile to be introduced into the seabed.

18. The device according to claim 4, wherein a template is configured as the transport housing.

15 19. The device according to claim 4, wherein the second end of the hydro sound absorber is positionable remote from the holding mechanism.

20. The device according to claim 4, wherein the transport housing comprises a first annular basket and a second annular basket, wherein the first annular basket is configured to be pushed into the second annular basket.

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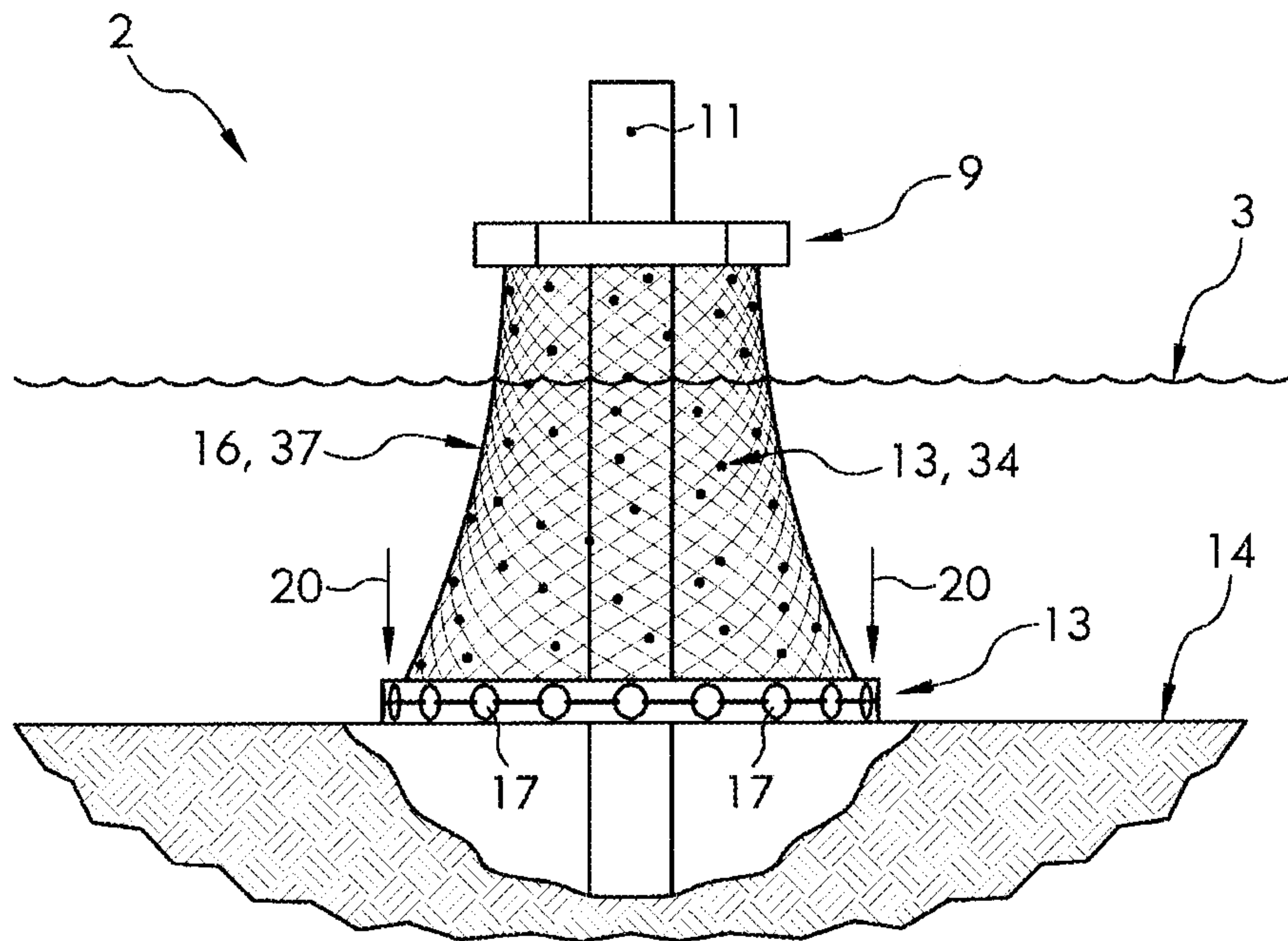


FIG. 1

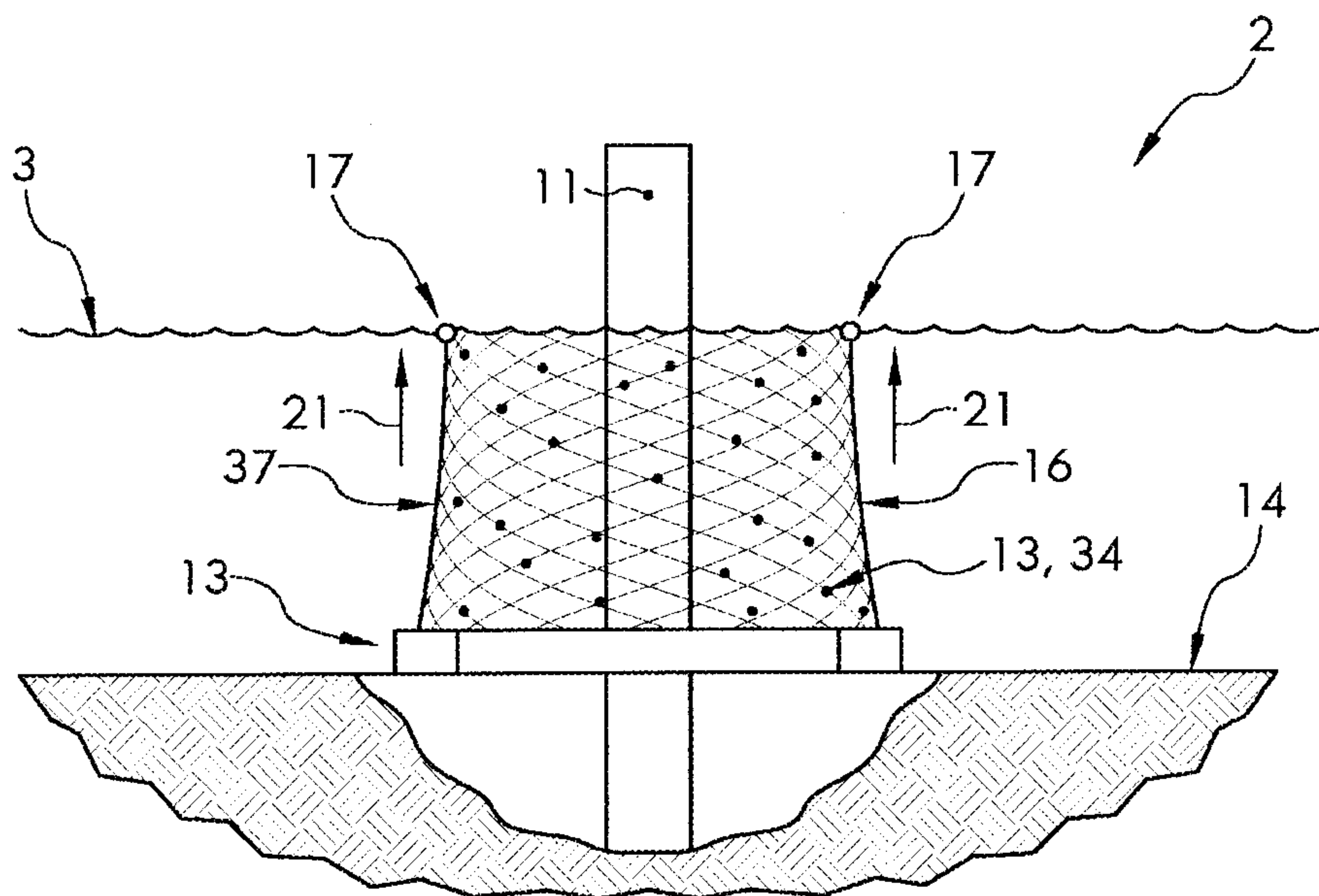


FIG. 2

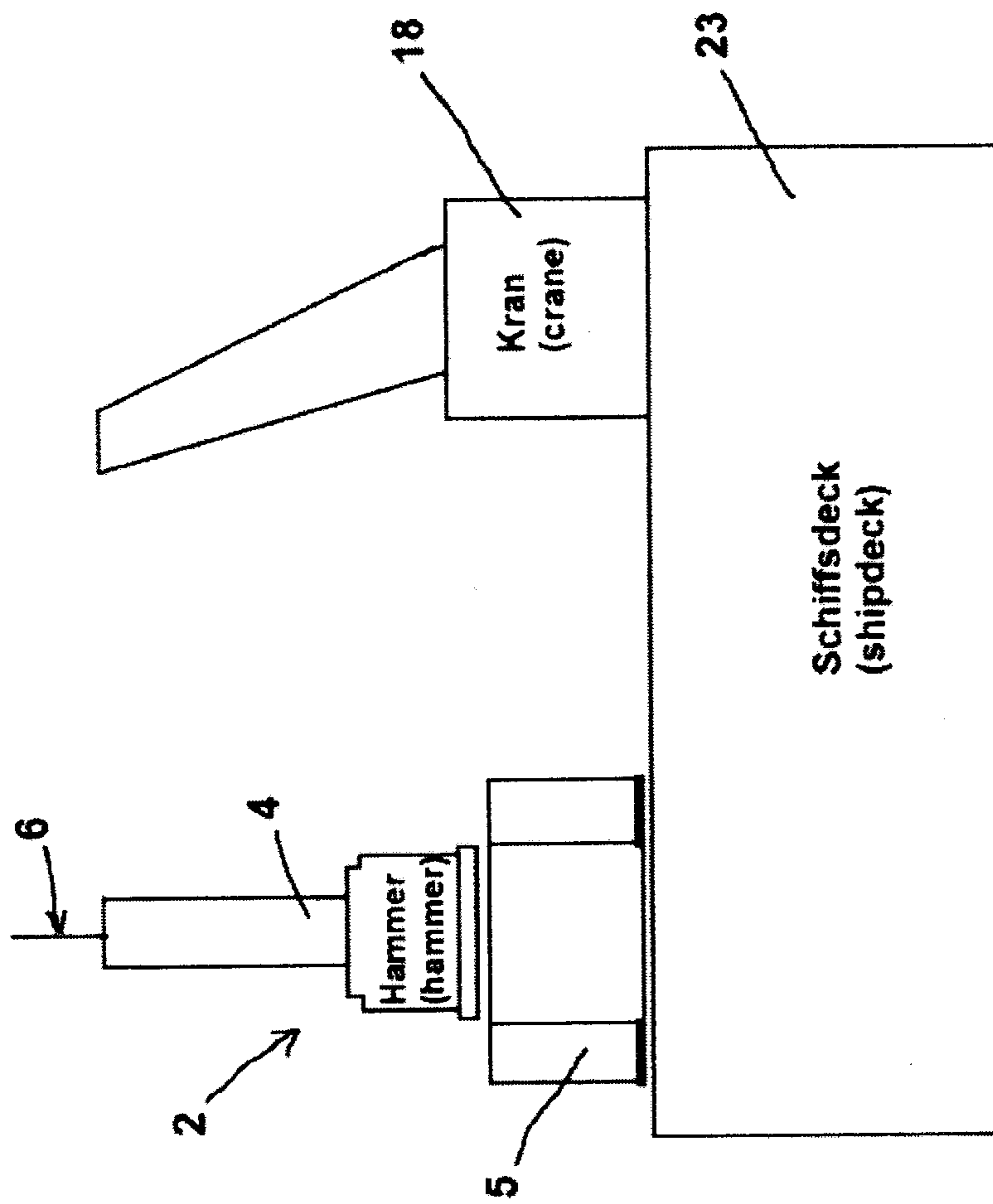
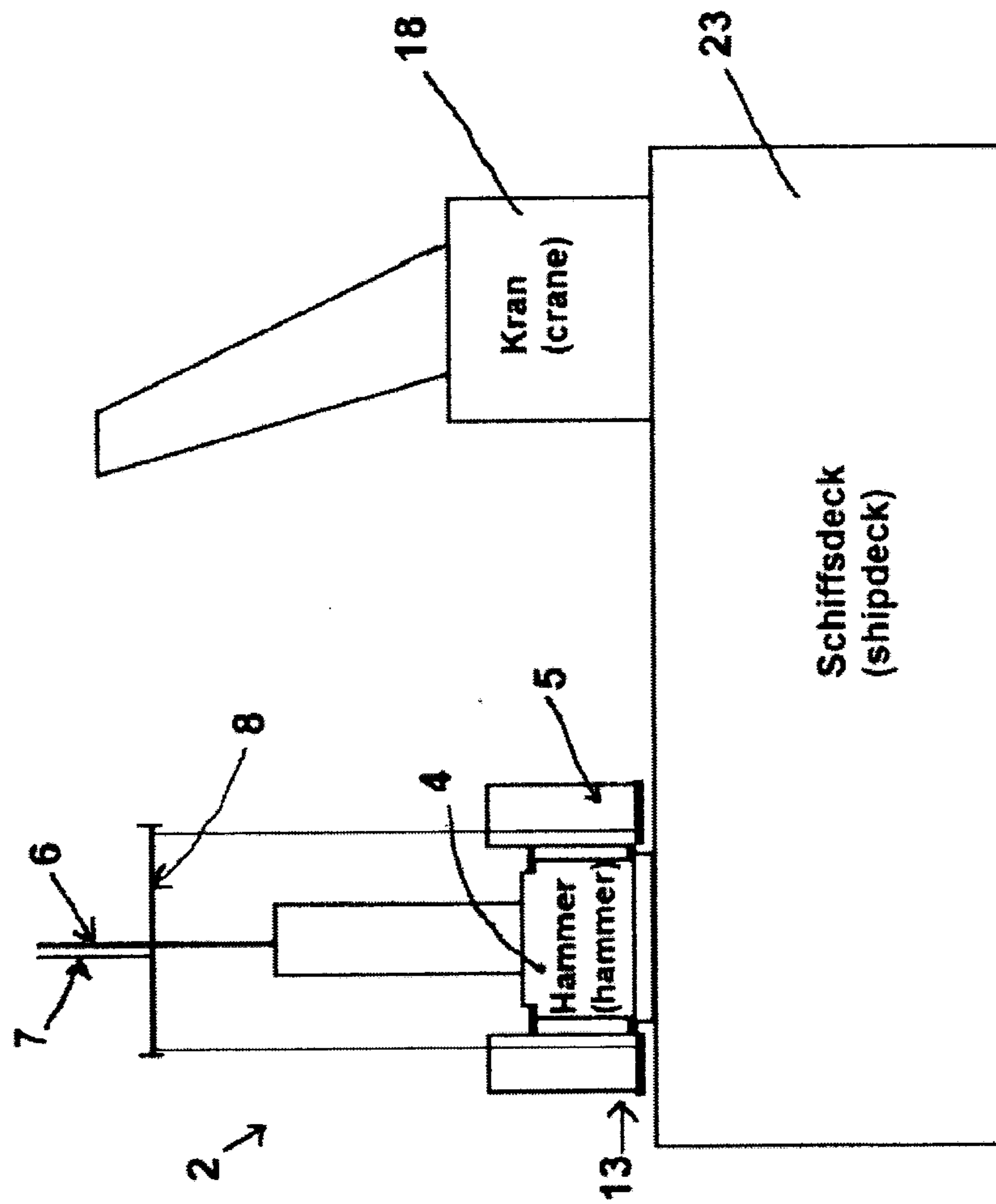
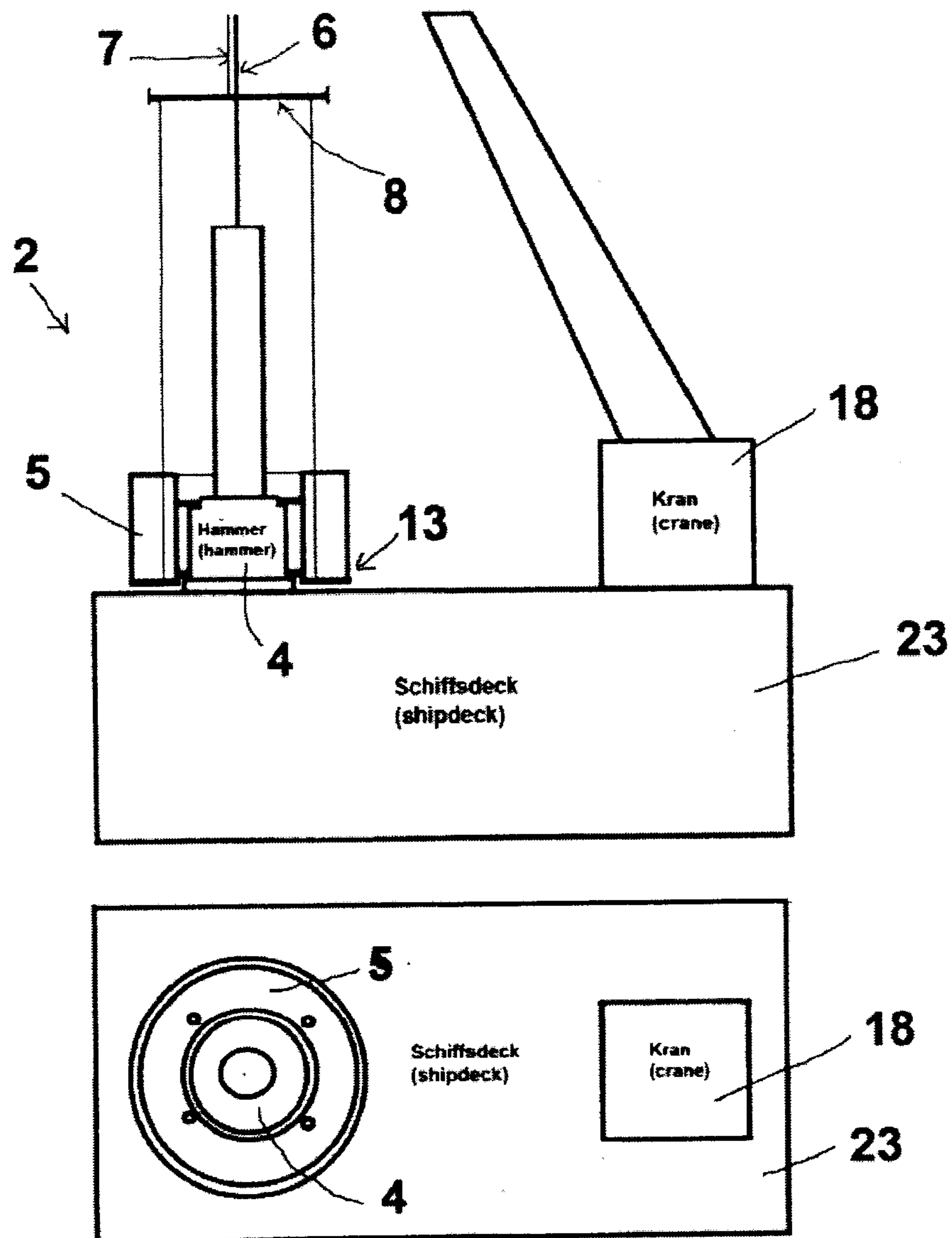


FIG. 3

**FIG. 4**

**FIG. 5**

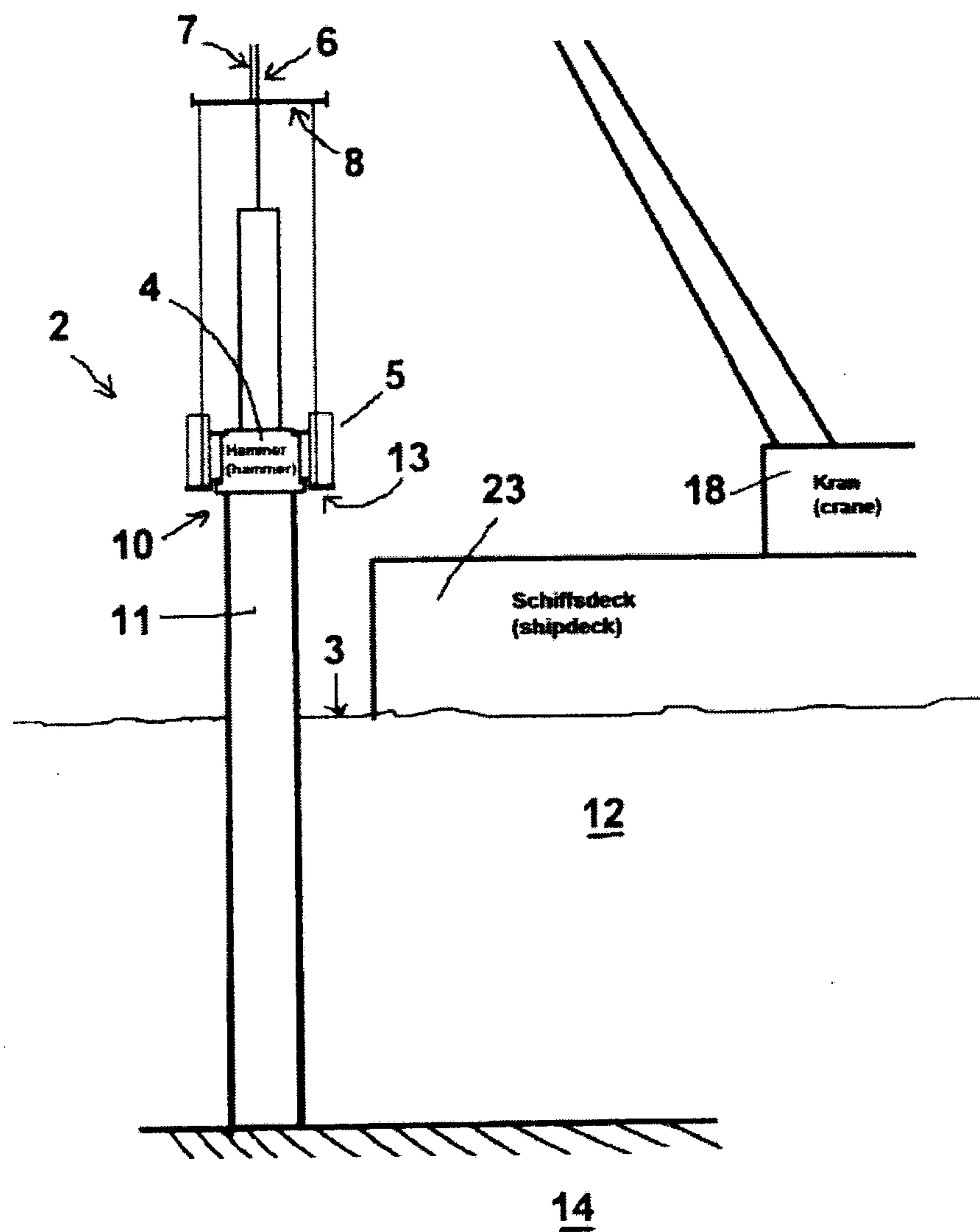
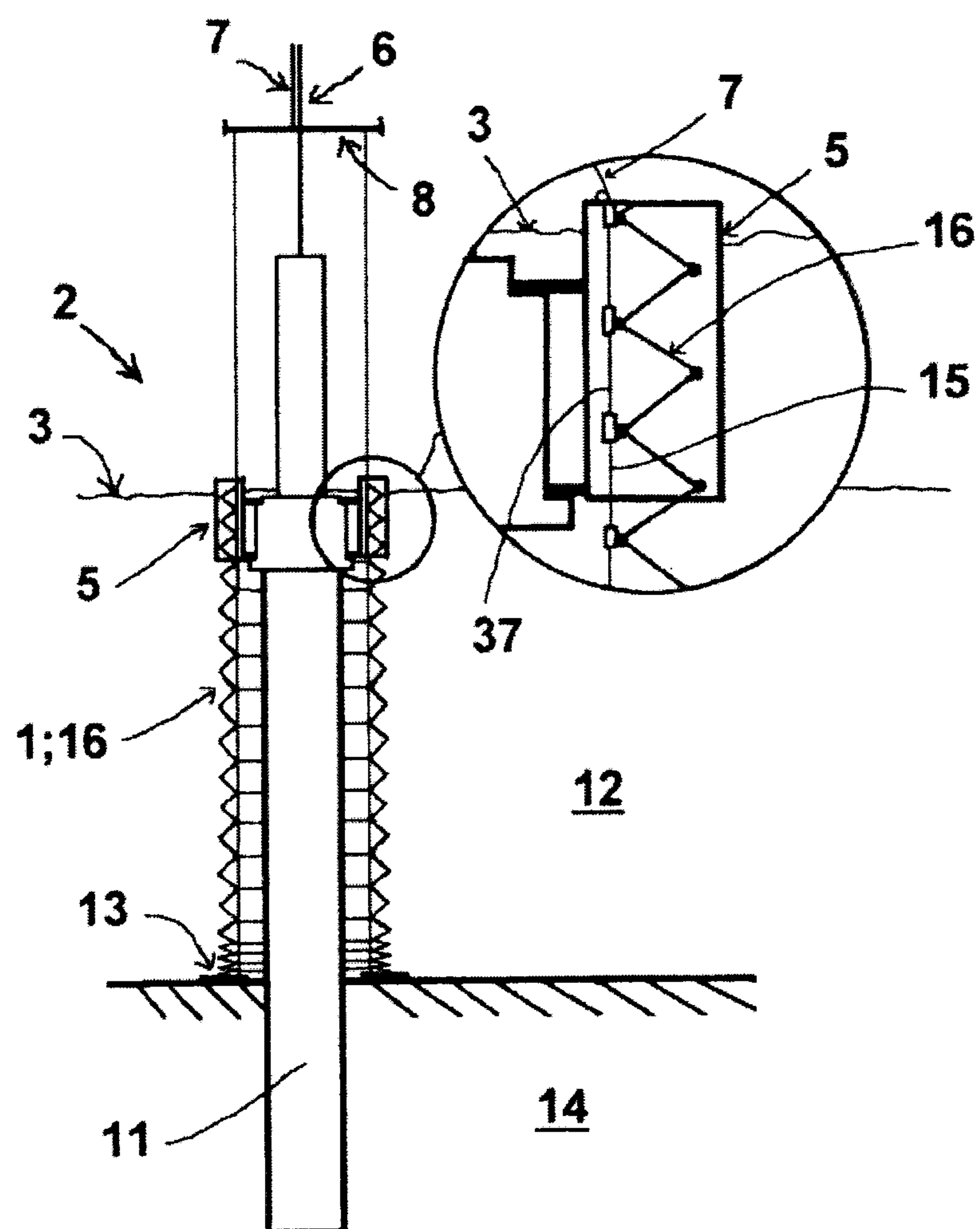
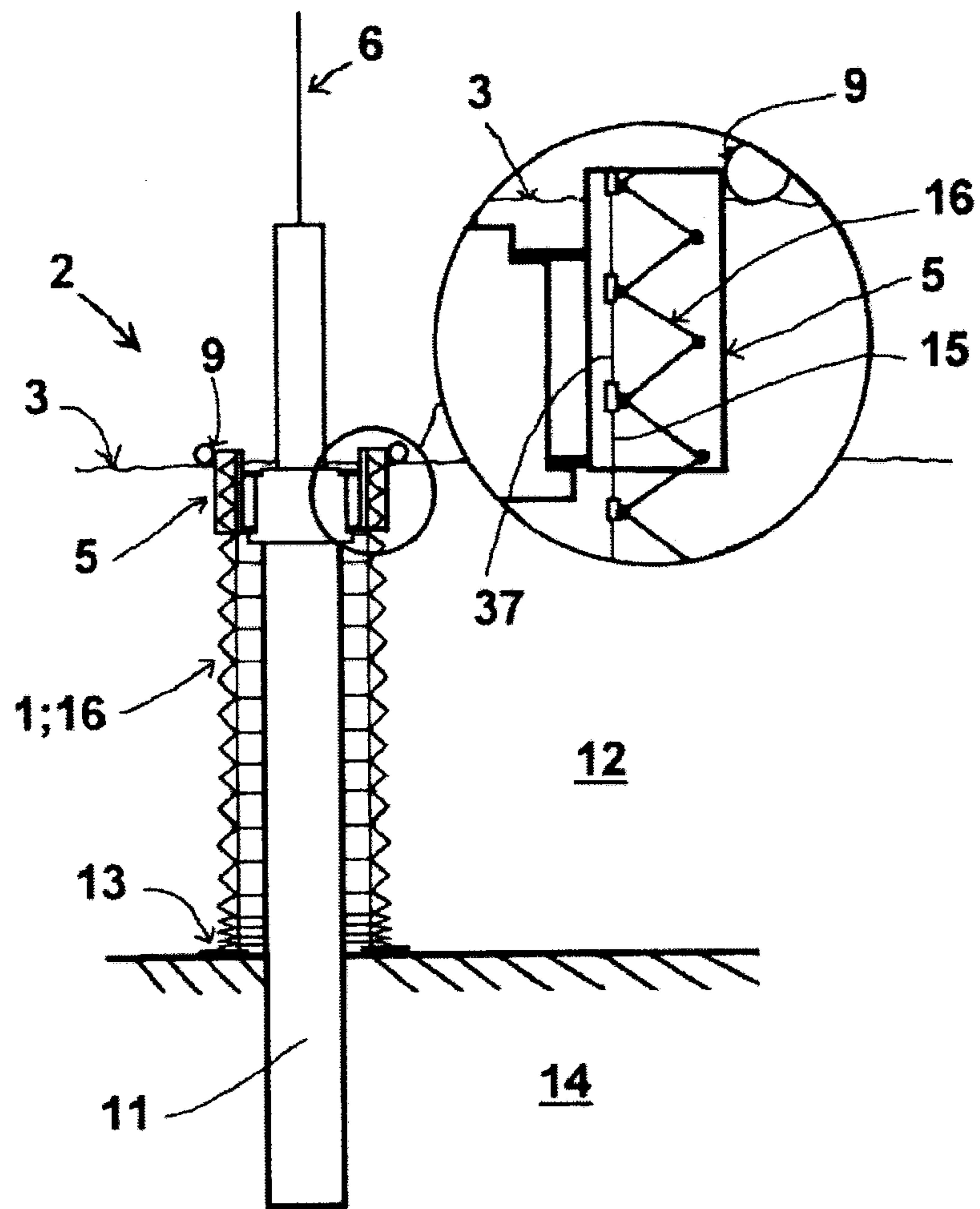


FIG. 6

**FIG. 7**

**FIG. 8**

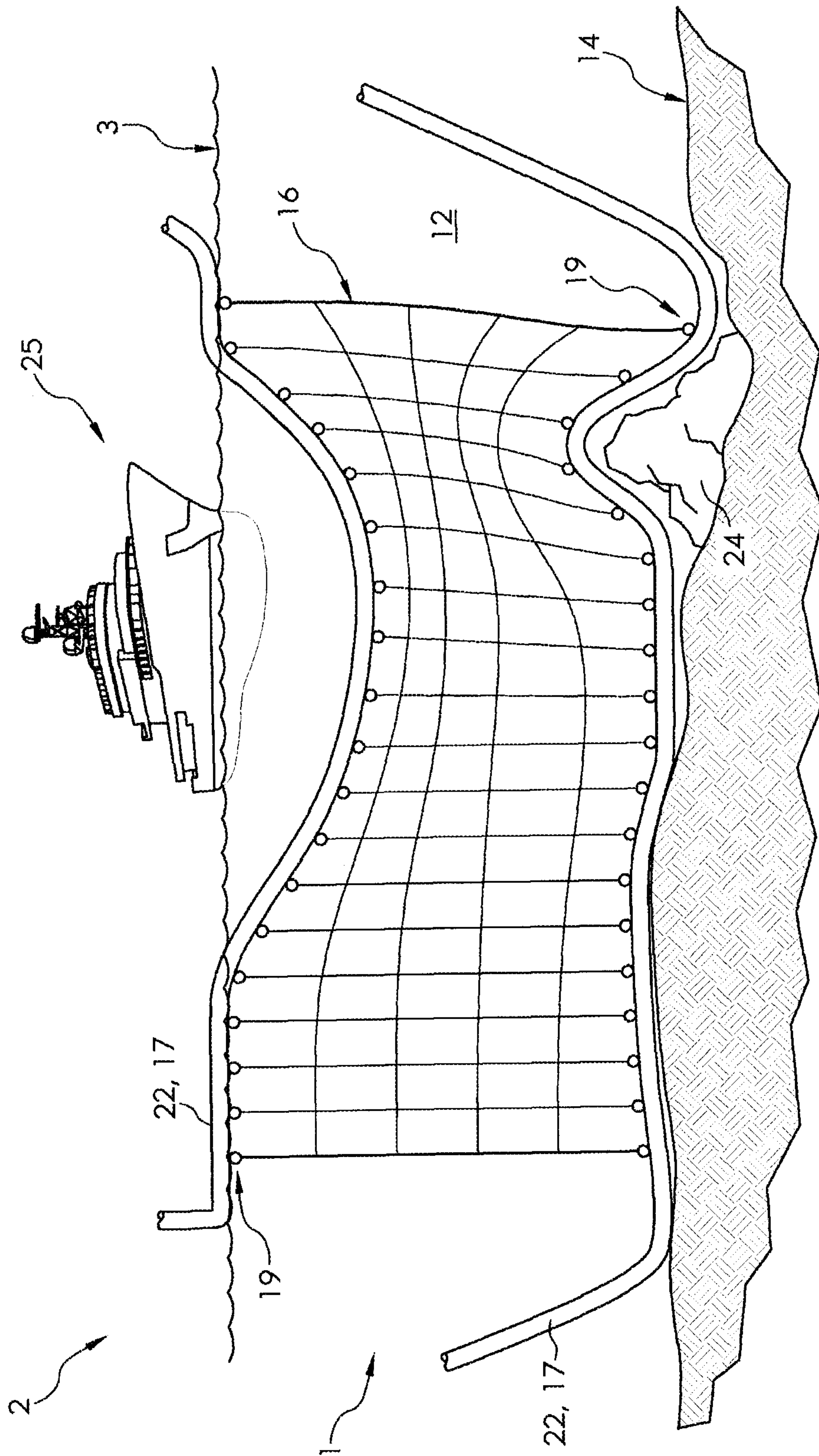


FIG. 9

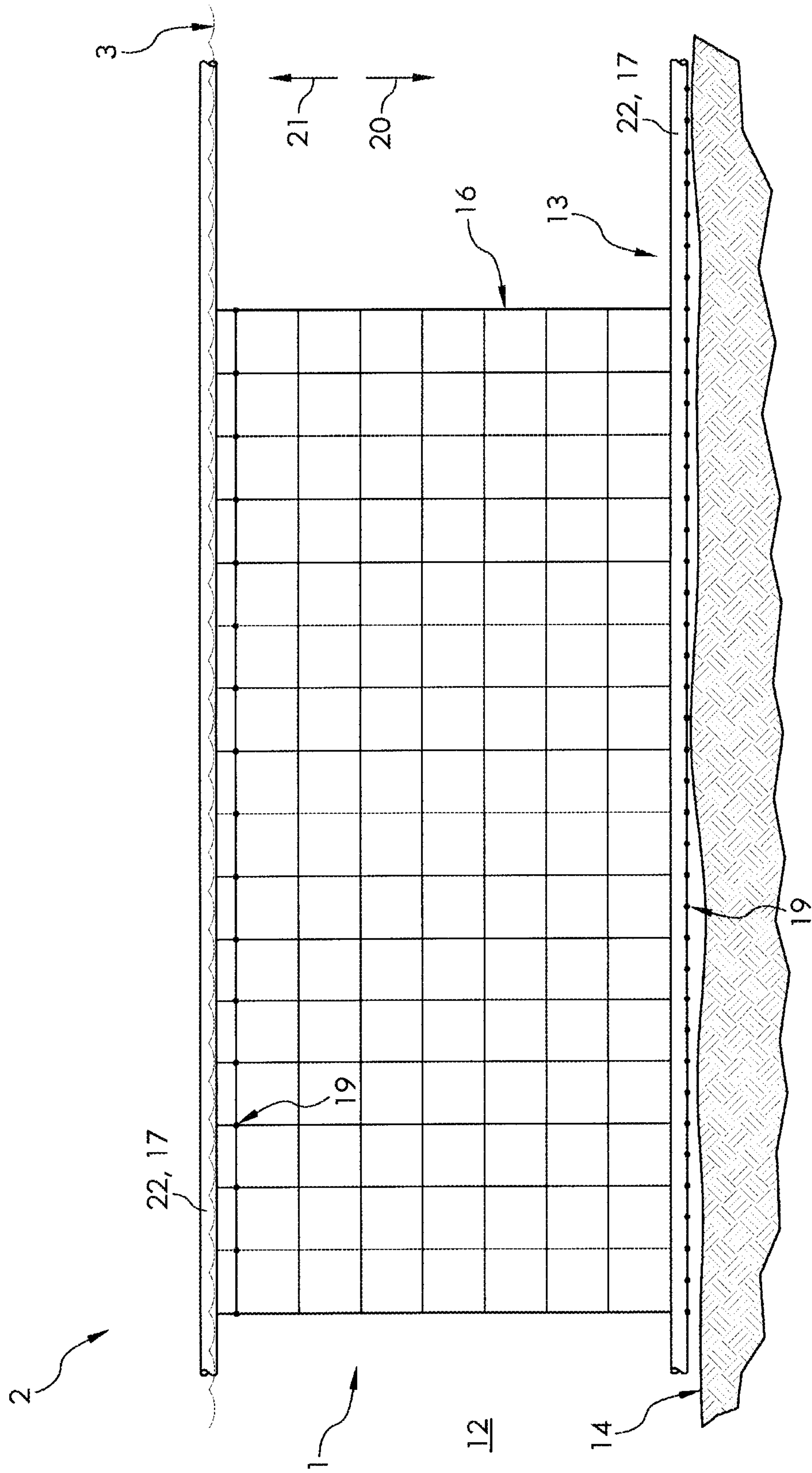
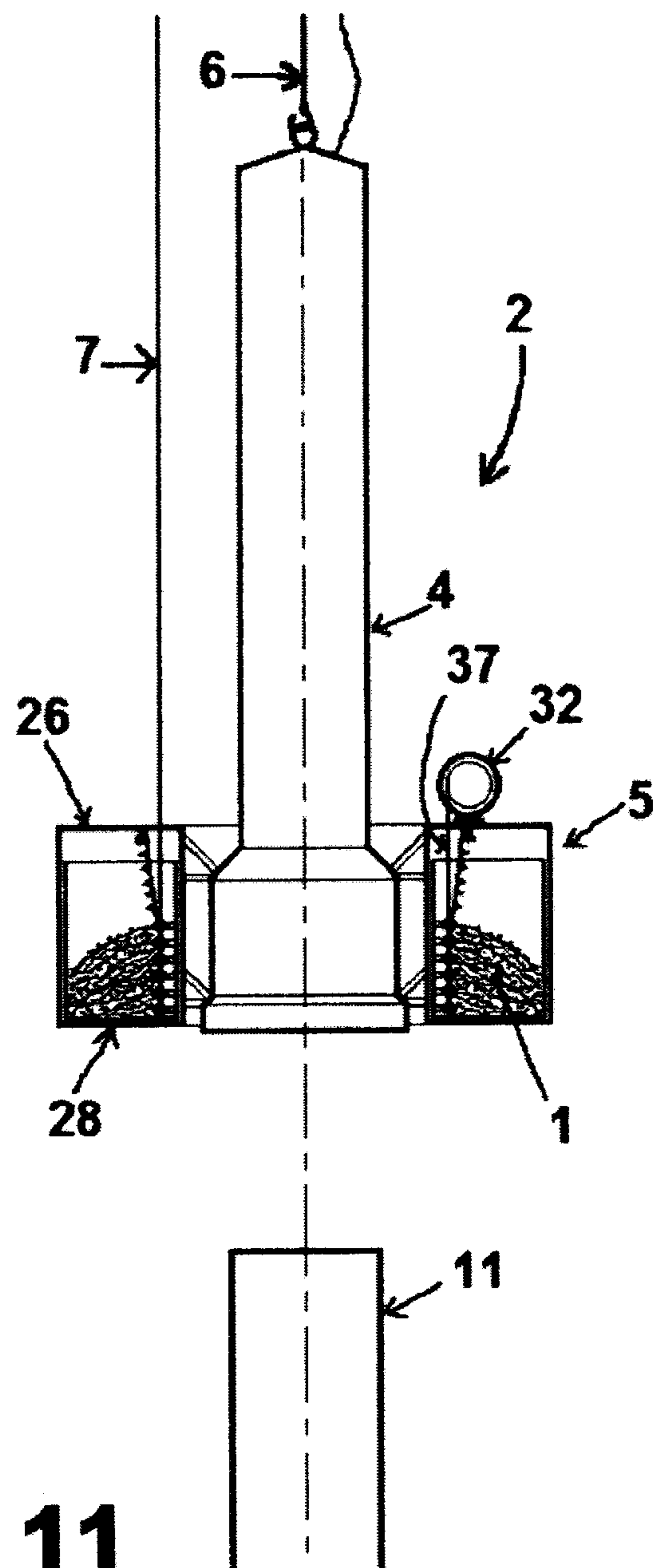
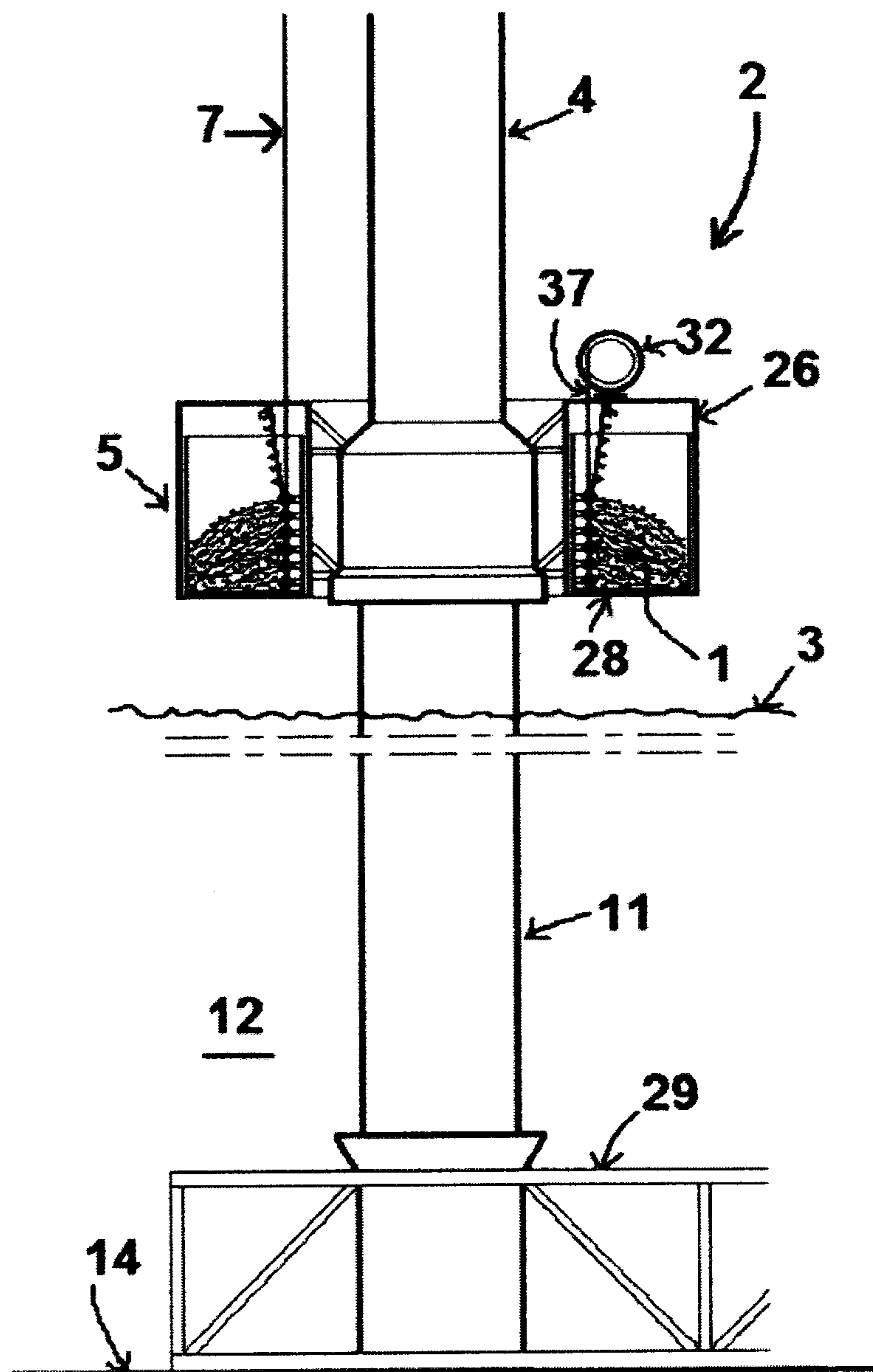
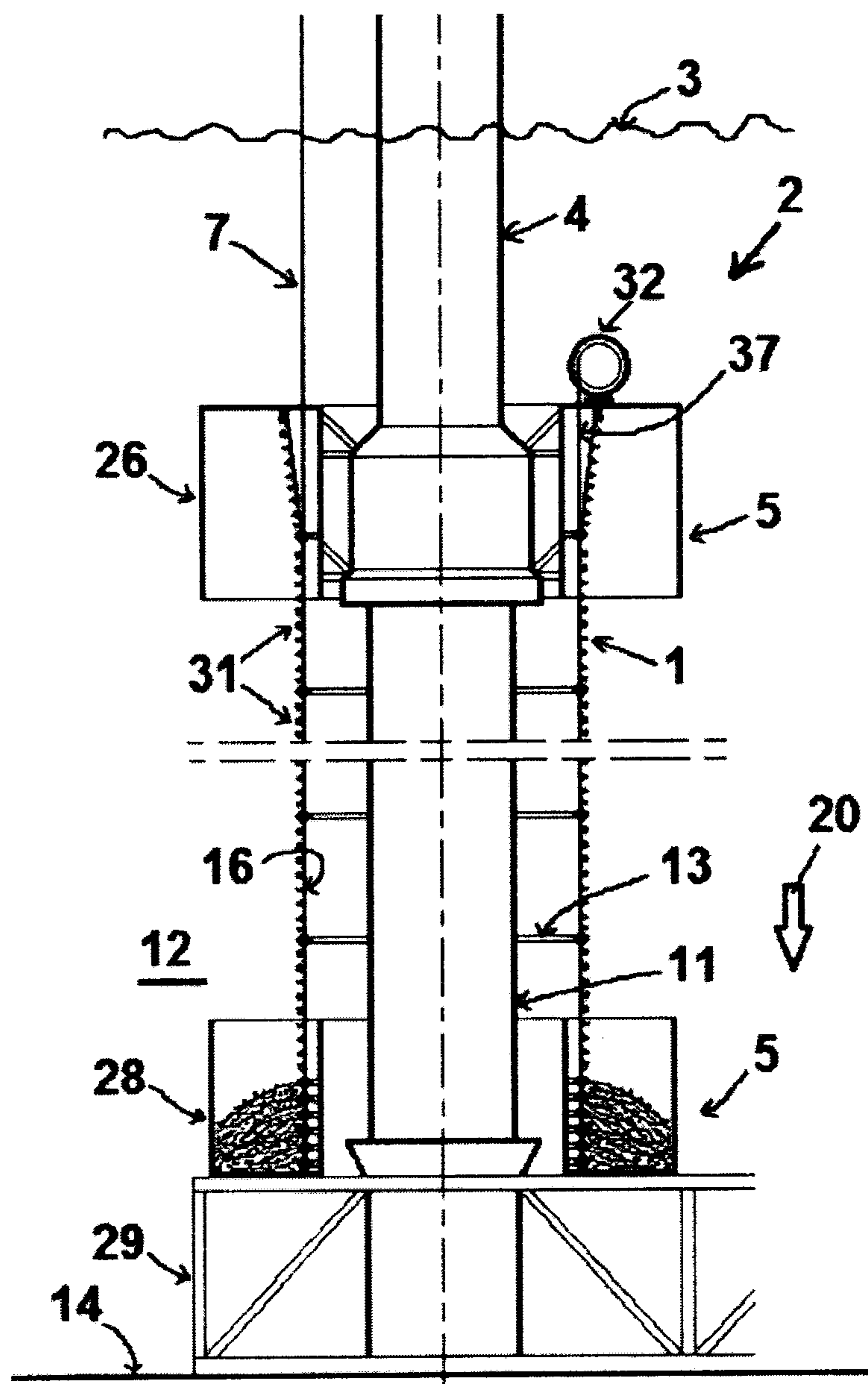
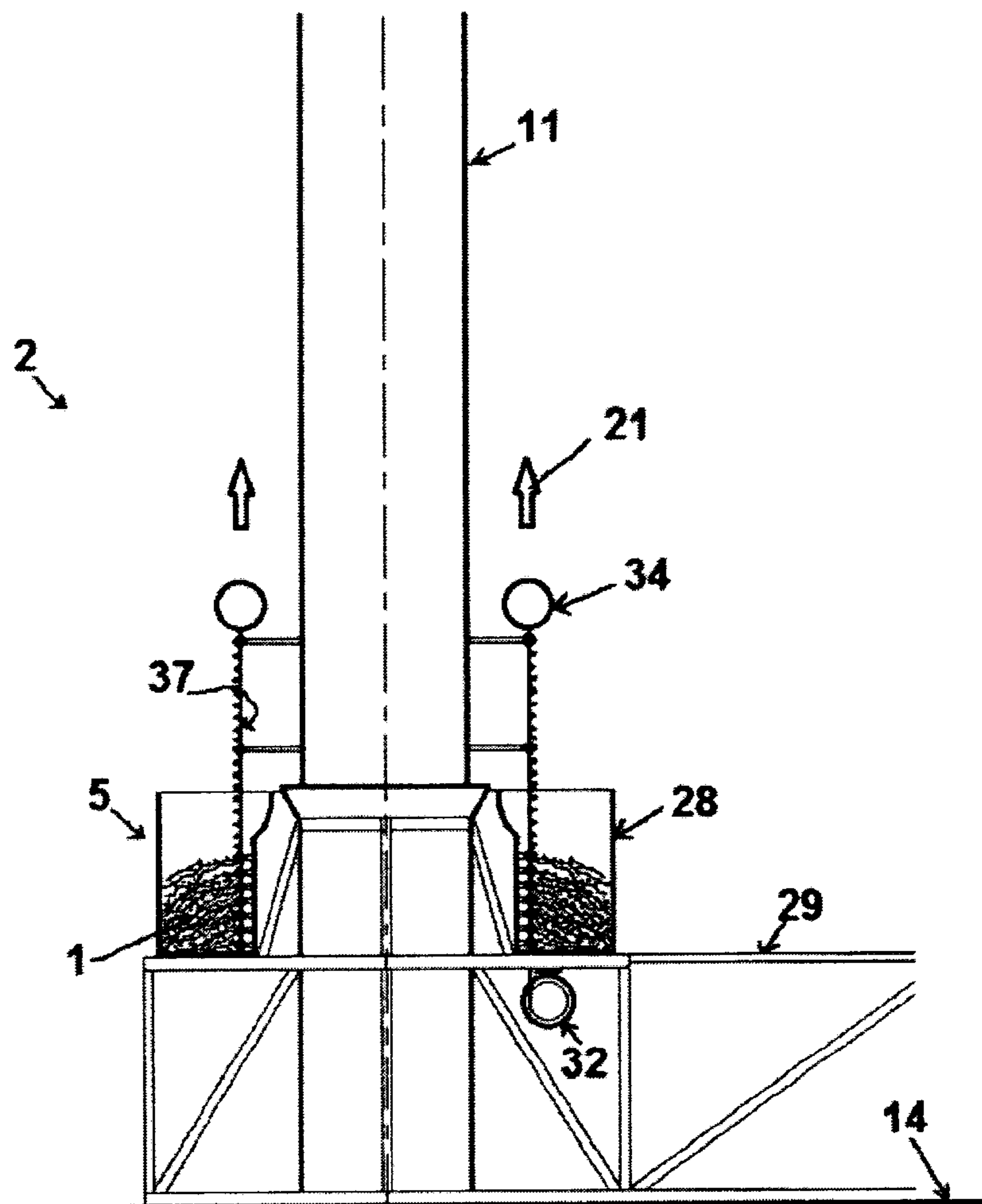


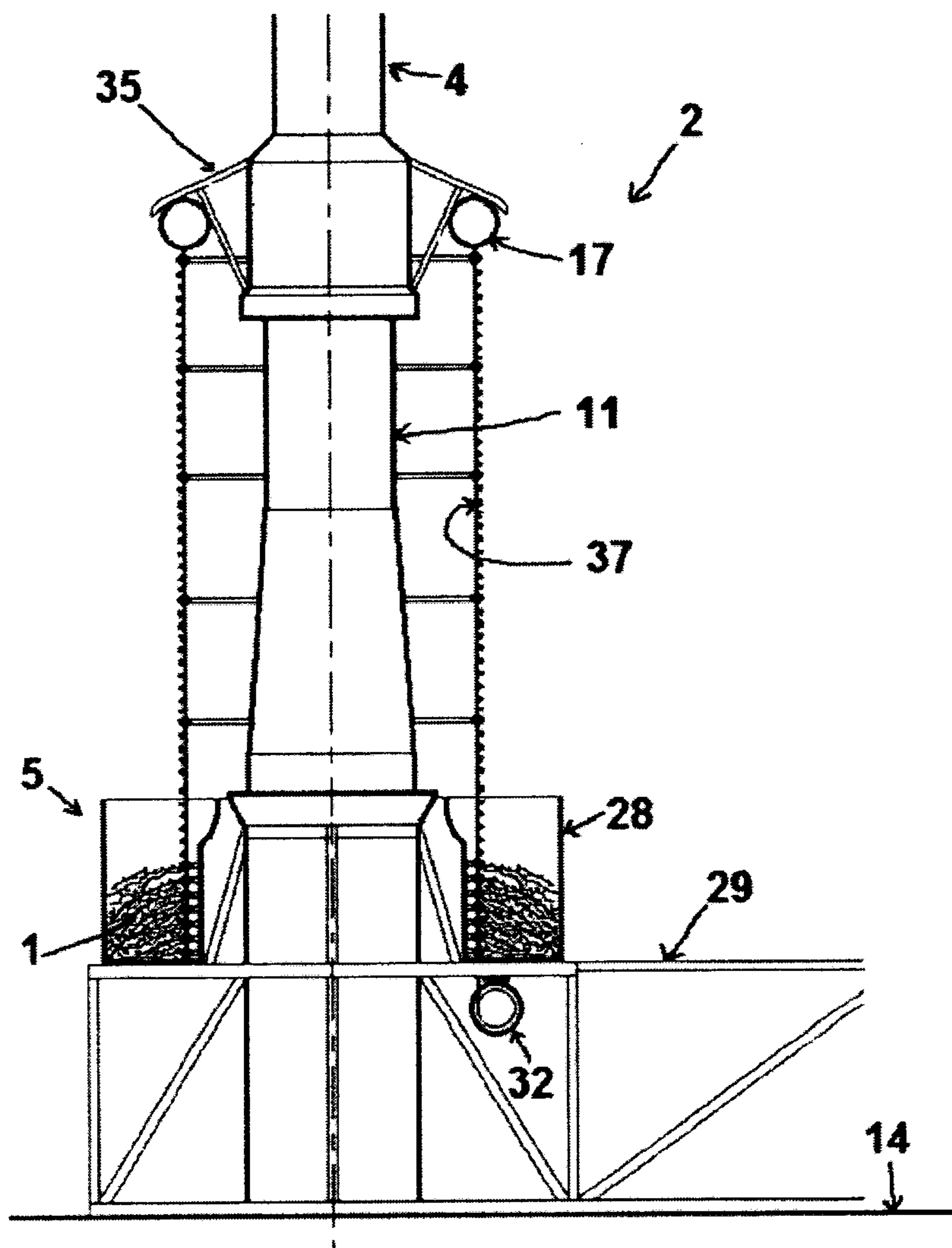
FIG. 10

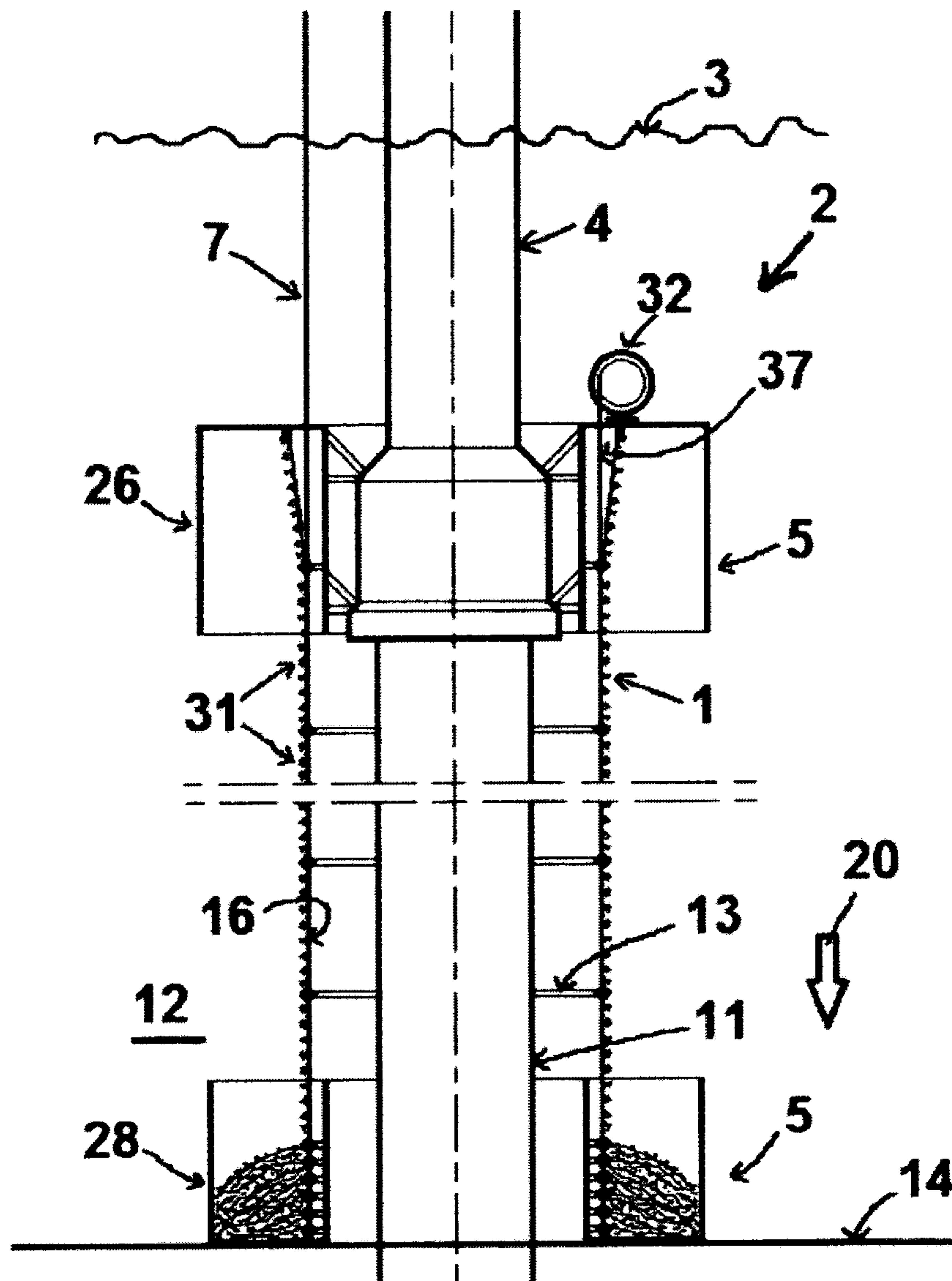
**FIG. 11**

**FIG. 12**

**FIG. 13**

**FIG. 14**

**FIG. 15**

**FIG. 16**

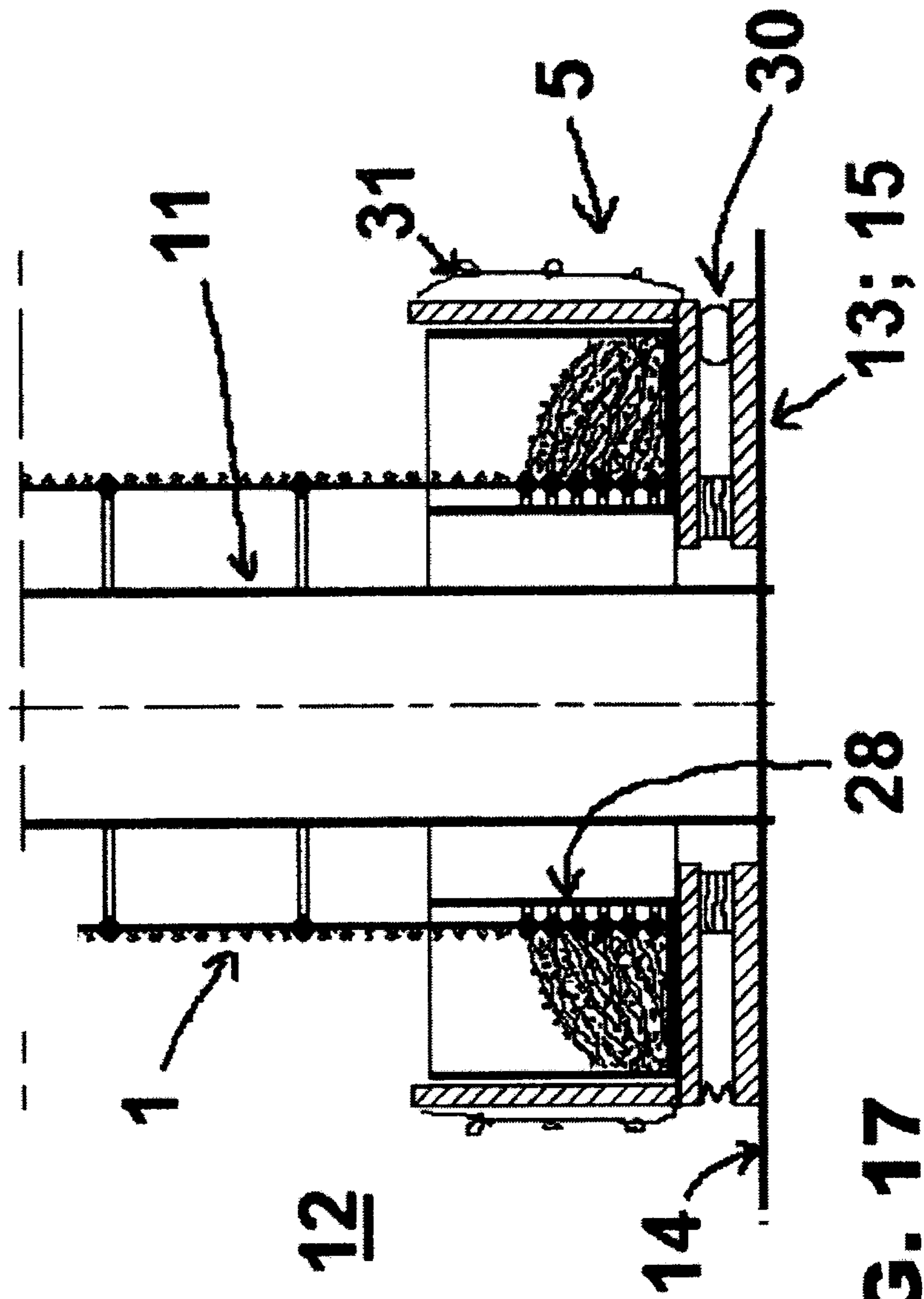


FIG. 17

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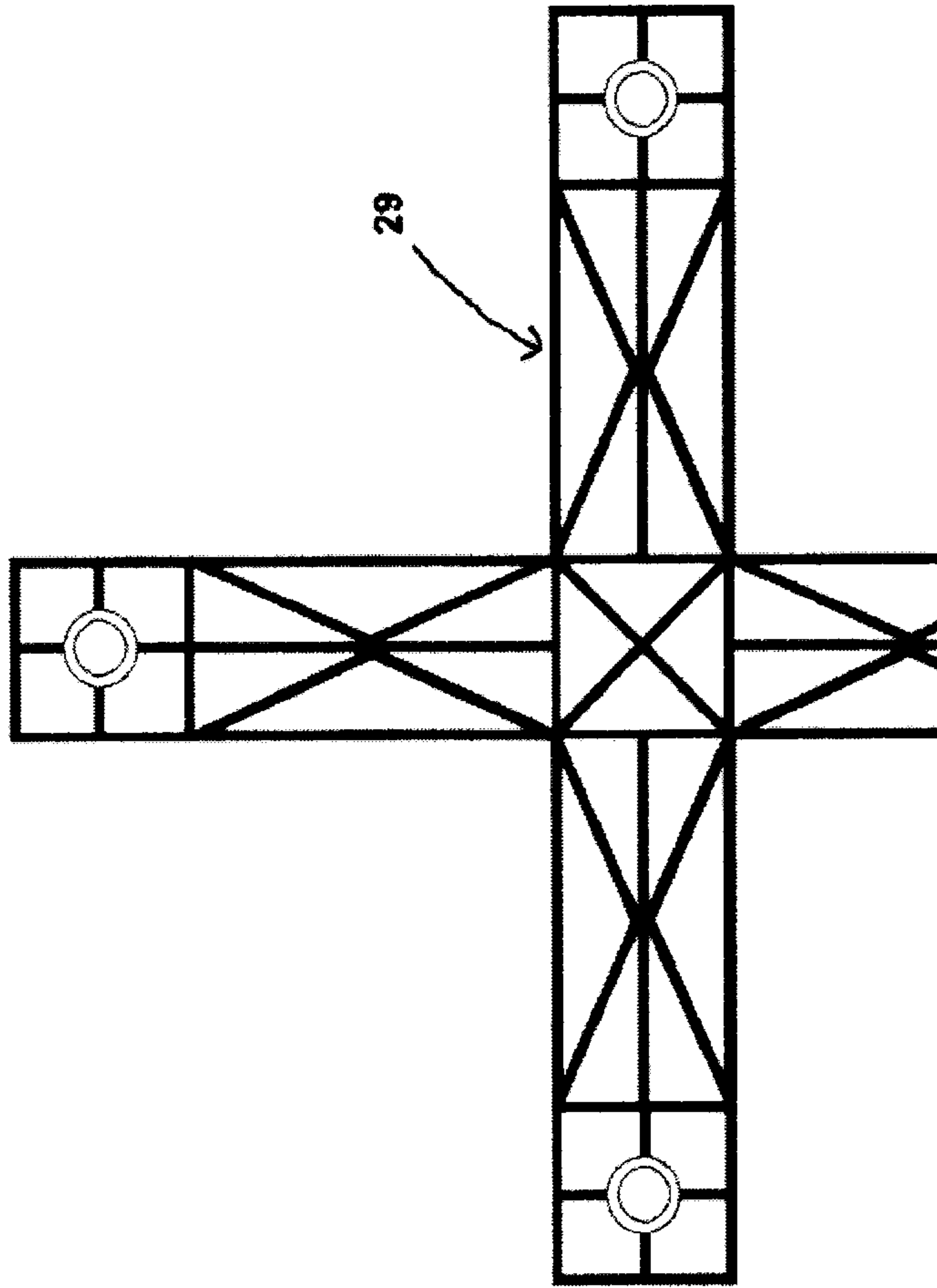


FIG. 18

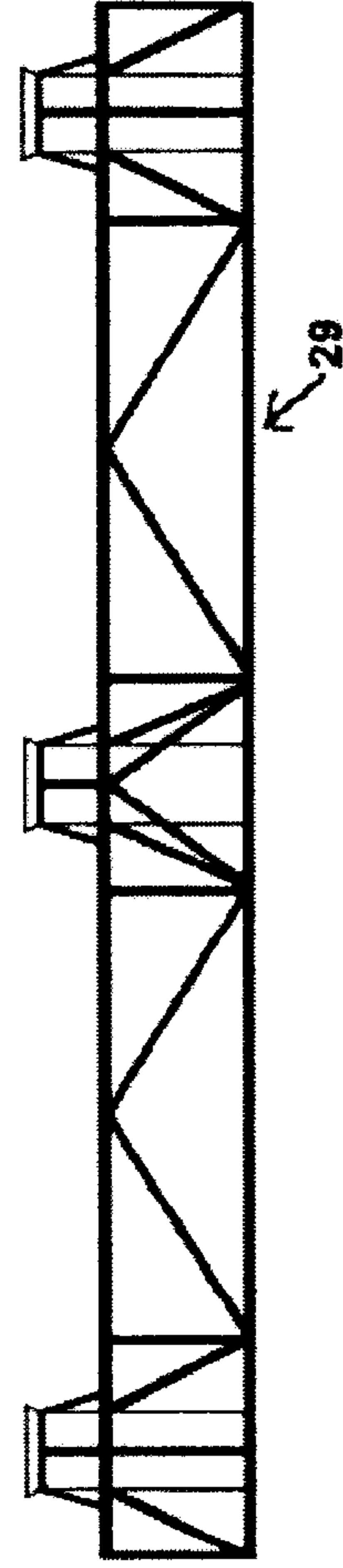


FIG. 19

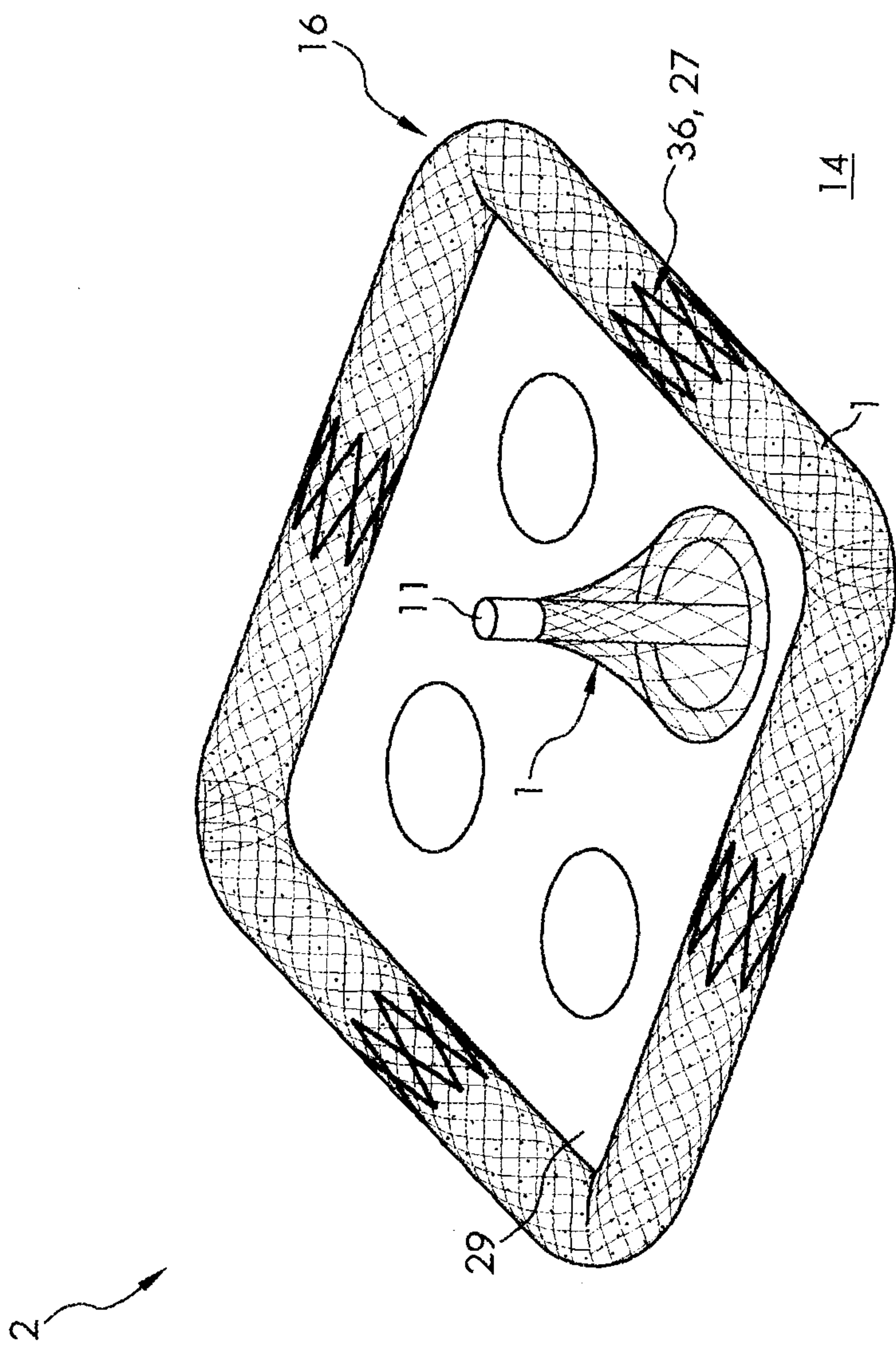


FIG. 20

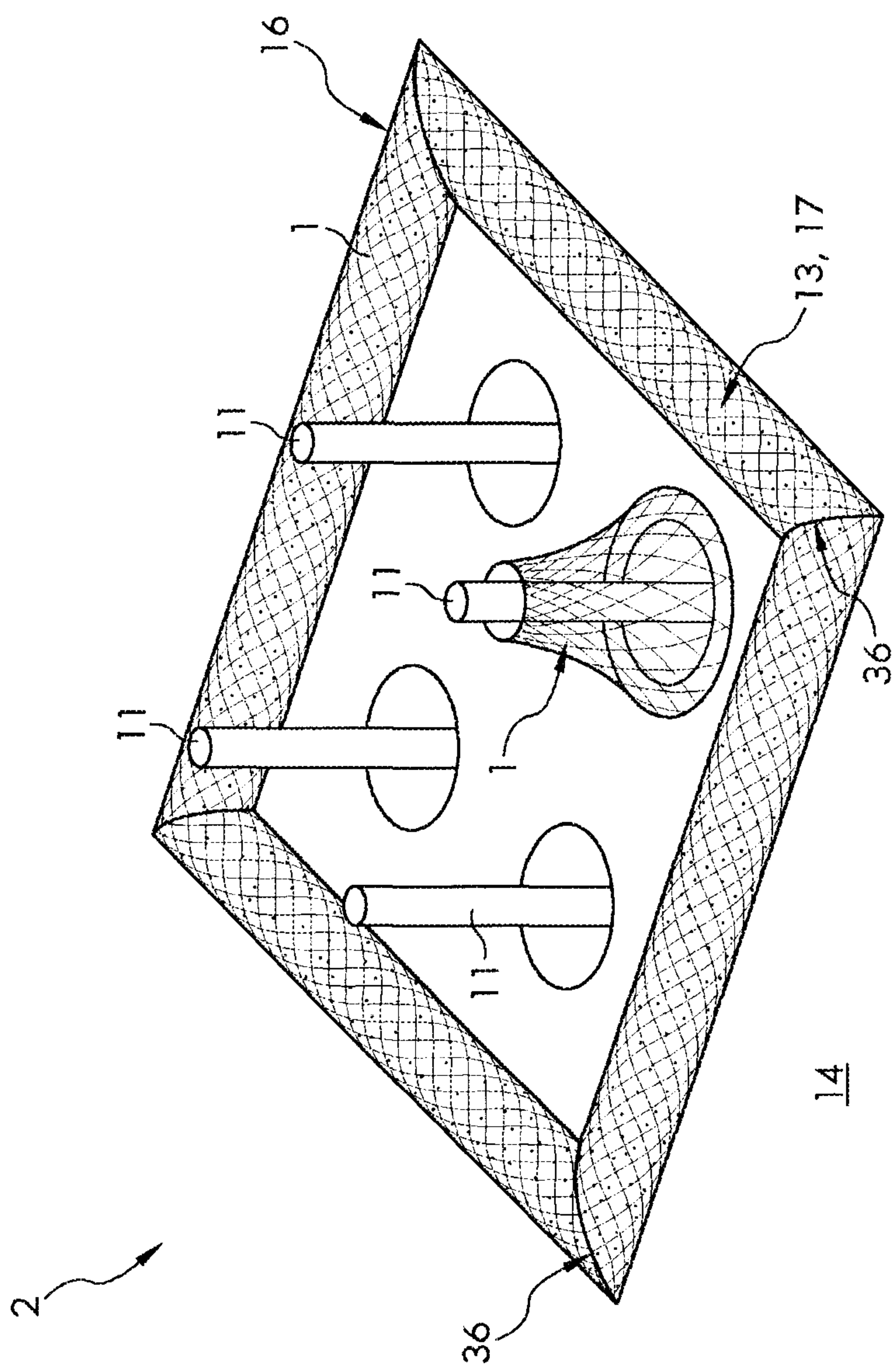


FIG. 21

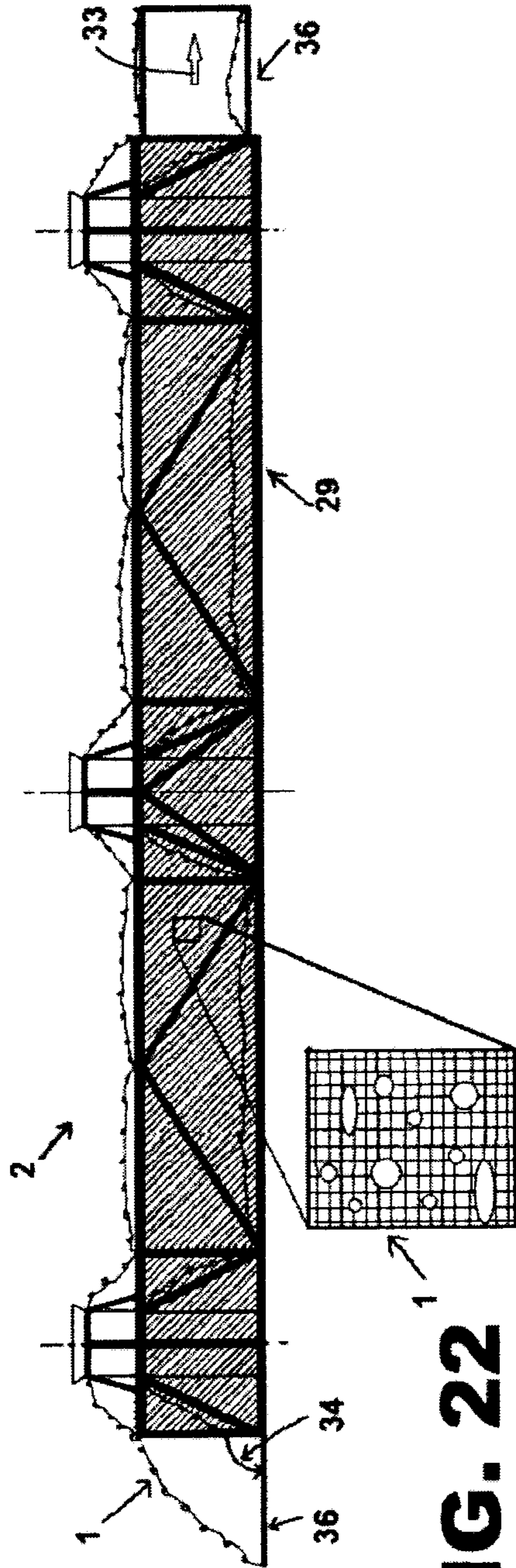


FIG. 22

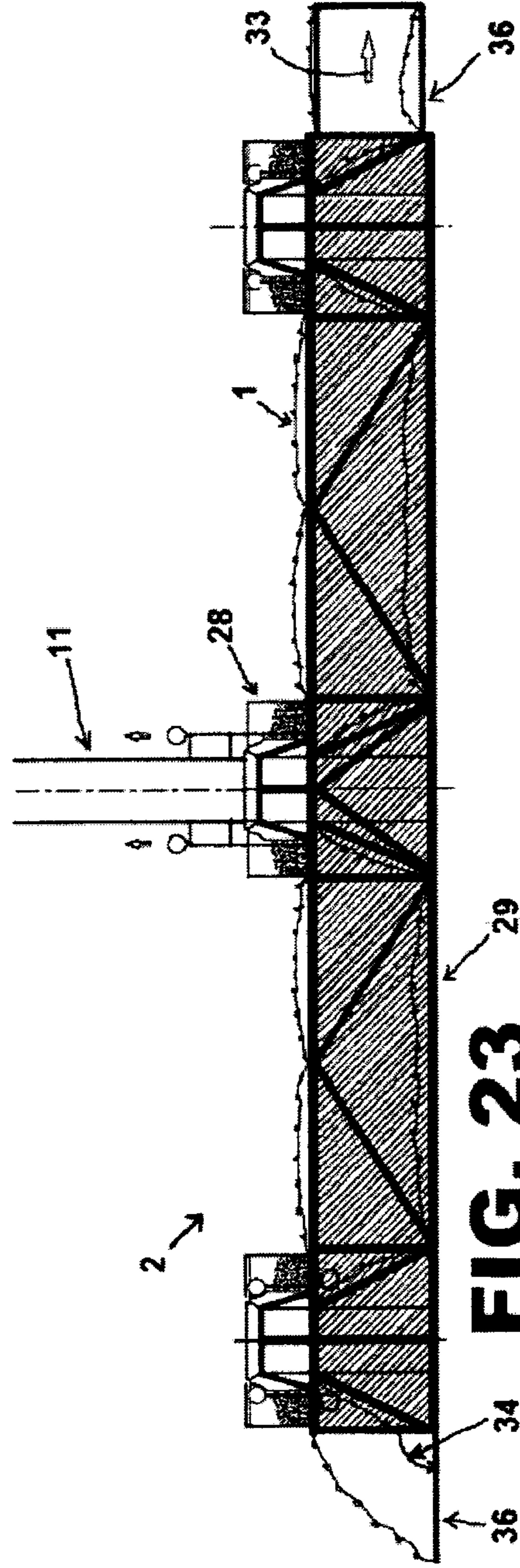


FIG. 23

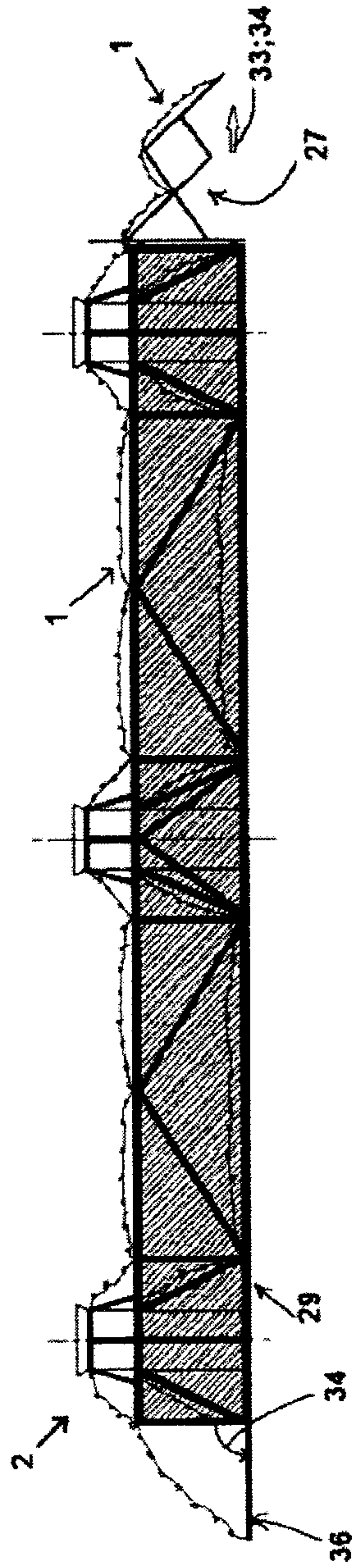


FIG. 24

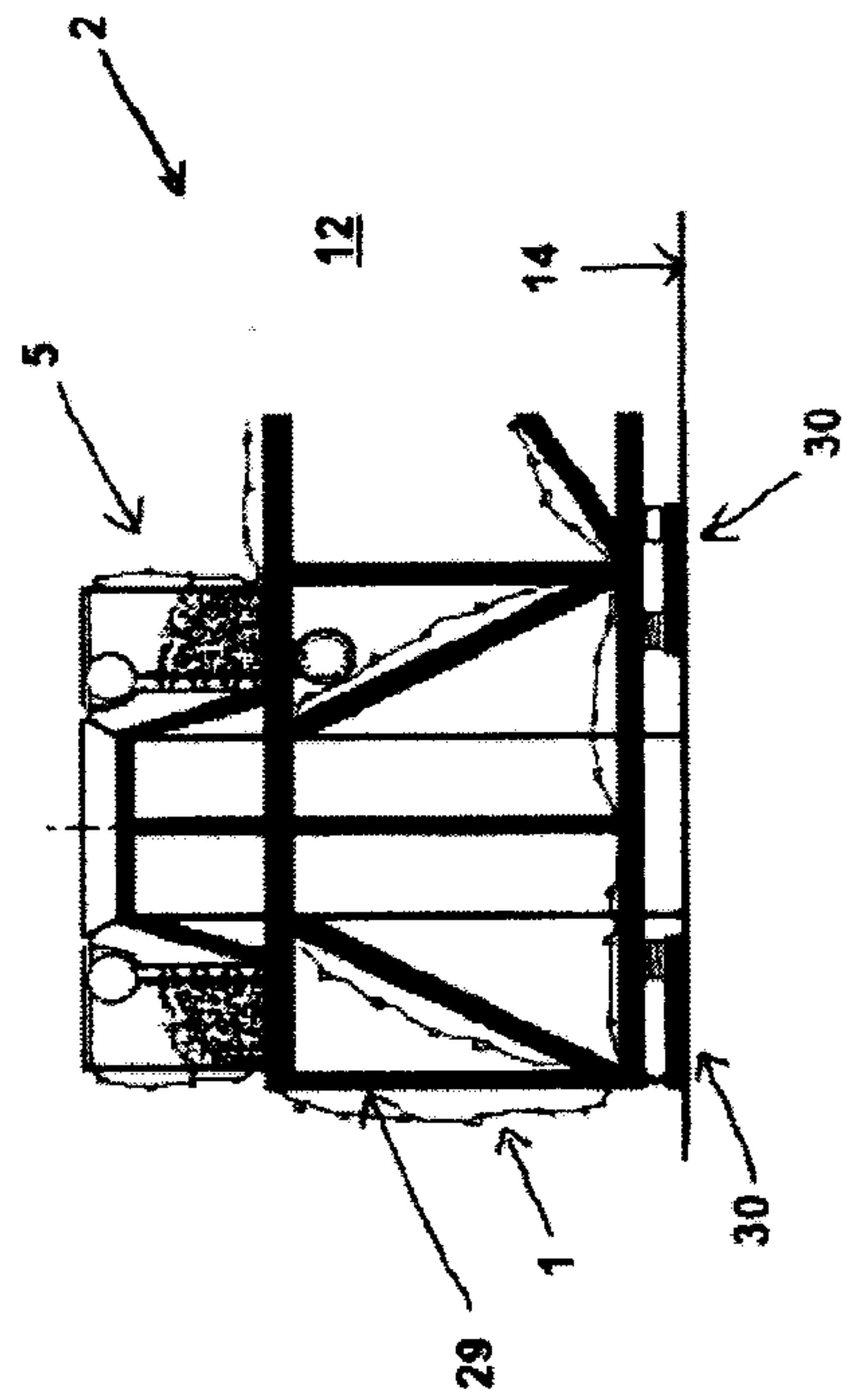


FIG. 25

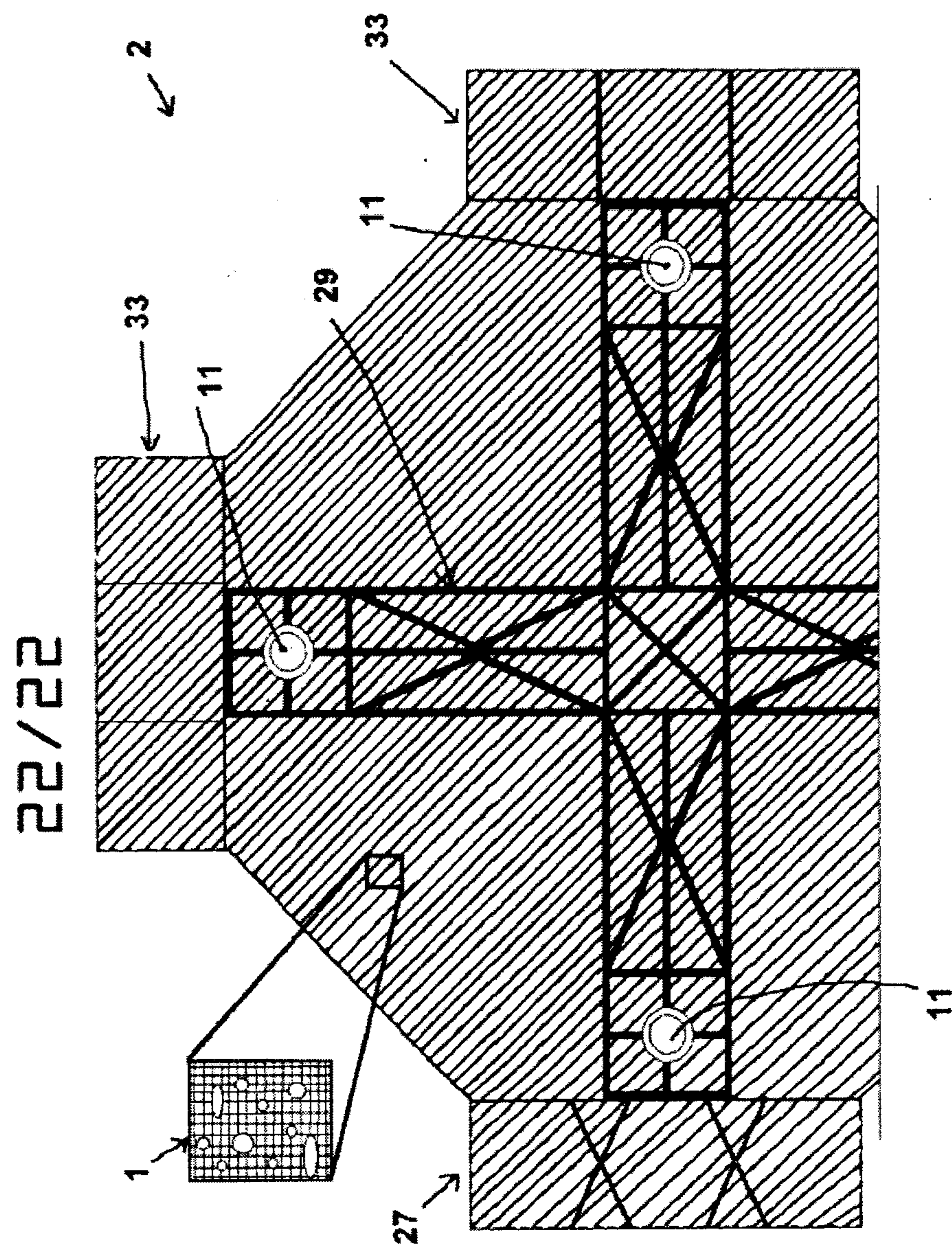


FIG. 26

