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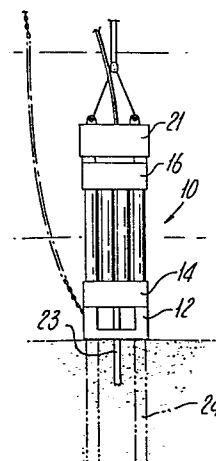
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54 Method of, and apparatus for, anchoring off-shore structures.

57 In a method of anchoring an off-shore structure, a floatable carrier (10) is loaded with piles (24), caused to sink at a selected location, and then used to drive the piles (24) into the ocean floor. The carrier (10) is then raised for reloading. A template (12) or other structure to be anchored by the piles can be secured to the carrier to be transported and positioned. Preferably, the piles are driven by the expansion and contraction of hydraulic cylinders (26) incorporated in the carrier. The arrangement disclosed avoids the difficulties encountered in past apparatus and proposals in securing efficient transfer of energy to the piles to be driven and in positioning the pile driving mechanism in relation to the piles.

Fig. 4.



"Method of, and apparatus for, anchoring off-shore structures"

The present invention relates to the anchoring of off-shore structures, and, more particularly to a method of, and apparatus for, driving piles to anchor such structures.

5 The anchoring of off-shore structures has long presented difficult engineering problems, especially when the structures are to be permanent and the water is deep. Generally, the most favoured anchoring technique employs long piles driven into the ocean floor. In areas where heavy storms are common, the time that is available in which to drive the piles, allowing
10 an adequate margin of safety, can be a severe limiting factor and can render the driving of piles to the desired depths problematic or impractical.

Traditionally, such piles are driven by large above-water hammers supported by barge-mounted cranes. The hammer force is transmitted to
15 the piles by long steel shafts. The longer the shaft, the more energy is dissipated into the shaft itself with less energy being available at the pile. Pile driving thus becomes more and more difficult, time consuming and expensive as the water depth increases.

20 More recently, piles have been driven by underwater hammers. While those hammers are likewise supported by barge-mounted cranes, they eliminate the long energy-dissipating drive shafts, thus increasing efficiency in some situations. However, the underwater manipulation of the piles and the hammer is still a difficult problem.

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One important use for off-shore structures is in relation to oil and gas well drilling and production platforms. Generally speaking, the upper limit of the water depth at which these platforms can be built, using current technology, is about 1,000 feet. The demand for crude oil, which is less and

less available at easily accessible locations, has created a need for oil and gas wells at deep water locations. The Gulf of Mexico is one area where many such deep water locations exist and platform construction is further complicated by frequent severe storms.

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A variety of new and different platform arrangements have recently been proposed for deep water use. Some of these platforms are of the guy wire type, in which a guy wire platform is mounted atop a flexible tower that stands on the ocean floor. Lateral platform movement is limited by the guy wires which are anchored to the ocean floor at outlying positions. A major problem, of course, is how to anchor the wires.

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There has been proposed, for use in even deeper water, another type of platform employing a floating platform structure tied to the ocean floor by heavy cables. It has been proposed that in such an arrangement, these cables would hold the platform below the lowest level at which it would float if unrestrained, even in heavy areas and at low tide. In this arrangement, the cables for the floating platform would, it is proposed, be attached at their lower ends to structures referred to as templates. Each template would be secured to the ocean floor by a plurality of piles. Cables capable of withstanding the loads that would be imposed by such floating platforms are made available by the present state of the art. As far as the applicants are aware, however, no such platforms have been built, and this is believed to be due, at least in part, to the difficulty in driving the piles to anchor the templates.

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While the construction of deep water oil and gas well platforms is a current problem of major significance, there are, of course, many other uses for off-shore structures. The invention is, therefore, addressed to the general problem of anchoring such structures, but it is expected to find immediate and important application with respect to oil and gas wells.

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Thus, a primary objective of the invention is to provide an apparatus and method of greatly improved effectiveness and efficiency for driving piles to anchor underwater structures, particularly in deep water.

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According to one aspect of the present invention, there is provided a method of driving a pile into the ocean floor comprising the steps of: loading said pile into a floatable carrier; towing said carrier to a selected off-shore location; causing said carrier to sink to the ocean floor; causing a driving mechanism mounted on said carrier to drive said pile into the ocean floor by repeatedly expanding and contracting a hydraulic cylinder; and raising said carrier without said pile.

According to another aspect of the invention, there is provided a method of anchoring a structure to the ocean floor, comprising the steps of: loading at least one pile into a floatable carrier; securing the structure to be anchored to the bottom end of said carrier; towing said carrier and said structure to a selected off-shore location; causing said carrier to sink bottom end first to the ocean floor so that said carrier comes to rest on said structure; causing a driving mechanism mounted on said carrier to drive said pile through said structure into the ocean floor by repeatedly expanding and contracting a hydraulic cylinder; releasing said structure from said carrier; and raising said carrier.

According to a yet further aspect of the invention there is provided a carrier for use in anchoring a structure to the ocean floor, said carrier comprising: at least one pile guide adapted to receive a pile for use in anchoring said structure; drive means for driving said pile along said pile guide into the ocean floor, said drive means comprising an expandable hydraulic cylinder disposed in said pile guide and slip means for securing said cylinder to said guide to apply a reaction force to said carrier as said pile is driven; and ballast tank means for selectively causing said carrier to float in a horizontal position or sink in a vertical position.

Embodiments of the invention are described below by way of example with reference to the accompanying drawings, in which:-

FIGURE 1 is a diagrammatic illustration of a carrier and a structure to be anchored being towed to a selected site;

FIGURE 2 is an enlarged diagrammatic illustration of the carrier and structure being towed, the carrier and structure being shown in phantom

lines in transition from the horizontal towing position to the vertical sinking position;

FIGURE 3 is an illustration, similar to Figure 2, showing the carrier
5 and structure descending to the ocean floor;

FIGURE 4 shows the carrier and structure resting on the ocean floor,
with piles being shown in a driven position in phantom lines;

10 FIGURE 5 is an enlarged and more detailed side elevation view
showing the carrier being raised, without the structure, which has now been
anchored, a part of the carrier being broken away to show one of the
hydraulic cylinders used to drive the piles;

15 FIGURE 6a is a further enlarged fragmentary view of a pile guide
with a portion shown broken away to expose a jacking cylinder;

FIGURE 6b is a view similar to Figure 6a but showing the jacking
cylinder in an expanded condition;

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FIGURE 7 is a plan view of the carrier;

FIGURE 8 is an enlarged fragmentary view, partially in section,
showing a latch mechanism which secures the carrier to the structure to be
25 anchored;

FIGURE 9 is a fragmentary view similar to Figure 8 showing the
carrier being disengaged from the structure to be anchored;

30 FIGURE 10 is an enlarged fragmentary sectional view of the pile
guide showing a slip mechanism;

FIGURE 11 is a plan view of a template;

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FIGURE 12 is a plan view of another construction of template;

FIGURE 13 is a side elevation view of the template of Figure 12;

FIGURE 14 is a schematic illustration showing a first mode of engagement of the carrier with the template of Figure 12;

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FIGURE 15 is a schematic illustration similar to Figure 14 showing a second mode of engagement of the carrier with the template;

10 FIGURE 16 is a plan view of yet another construction of the template;

FIGURE 17 is a side elevation view showing the template of Figure 16 with the carrier about to engage it on the left and with the carrier shown in phantom lines in engagement with the template on the right;

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FIGURE 18 is a side elevation view of still another template (with battered piles) and a carrier suitable for use with it;

20 FIGURE 19 is a side elevation view showing another embodiment of the invention used to drive a single pile, there being no separate template structure to be anchored;

FIGURE 20 is a side elevation view similar to Figure 19 showing the pile being driven;

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FIGURE 21 is a side elevation view similar to Figure 19 showing the carrier being raised after the pile has been driven;

30 FIGURE 22 is a plan view of a template similar to that shown in Figure 16 being transported by barge with four carriers in place;

FIGURE 23 is a side elevation view of the apparatus of Figure 22, and

35 FIGURE 24 is another side elevation view of the apparatus of Figure 22 after the template has been anchored and the carriers have been disengaged from the template.

The embodiments of the present invention to be described utilise a carrier 10, an exemplary carrier construction being shown in Figures 1 to 7 of the accompanying drawings. This carrier 10 is used to anchor a template 12 to the ocean floor, the template being a structure used to secure a mooring line for a floating or laterally movable structure such as an oil or gas well platform (not shown).

The carrier 10 is elongated having a square cross section, as best shown in Figure 7. It has two end frames 14 and 16 joined at the corners by tubular pile guides 18. Of course, a larger or smaller number of pile guides 18 could be included in the carrier 10, depending on the specific use for which it is intended.

There are eight tubular ballast tanks 20 that extend through the end frames 14 and 16 parallel to the pile guides 18, there being two such tanks on each side of the carrier 10. Each tank 20 is divided horizontally so that it can be filled at one end if desired. Mounted atop the upper end frame 16 is a hydraulic power plant 21. Thrusters 22 mounted on the frames 14 and 16 are capable of providing horizontally directed water jets to rotate or translate the carrier. Similar thrusters are used to position ships, barges and dynamically positioned drilling rigs and are known to those skilled in the art. The thrusters 22 are operated by the power plant 22. A spar that serves as a stab-in guide 23 projects downwardly from the centre of the frame 14 at the bottom end of the carrier 10 when the carrier is in a vertical position (as shown in Figures 3 to 5).

Each of the pile guides 18 is adapted to receive a tubular steel pile 24, as best shown in Figures 6a and 6b. Within each pile guide 18 is a permanently installed hydraulic pile jacking cylinder 26 that serves as a mechanism for driving the corresponding pile 24 by the extension of a rod 27. It will be understood that while the hydraulic jacking cylinders 26 are preferred it is also possible to use underwater impact hammers to drive the piles 24.

Selectively actuatable slip mechanisms 28 and 29 on each cylinder 26 can be used to secure the jacking cylinder to the surrounding pile guide 18 at any longitudinal position. The slip mechanisms 28 and 29 are arranged in

two circular rows. The mechanisms 28 of the top row prevent upward movement of the cylinder 26 within the corresponding pile guide 18. Downward movement of the cylinder 26 is prevented by actuation of the bottom slip mechanisms 29.

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Each top slip mechanism 28 consists of a ramp 30 immovably mounted on the outside of the jacking cylinder 26 and a wedge 32 that slides between the ramp and the inside surface of the surrounding pile guide 18, as best shown in Figure 10. A small hydraulic slip cylinder 34 associated with each wedge 32 can cause the wedge to move toward the top end of the carrier 10. Thus, when the wedges 32 are moved downwardly into engagement with the ramps 30, upward movement of the jacking cylinder 26 tends to force the wedges 32 outwardly into tight frictional engagement with the pile guide 18, thereby immobilizing the jacking cylinder. The bottom slip mechanisms 29 are of similar construction but are inverted. A third circular row of slips 35 at the bottom of the rod 27, having the same construction and orientation as the top slips 28 (shown in Figure 10), can be actuated to prevent upward movement of the rod within the pile guide 18.

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At the bottom of each rod 27 is a set of hydraulically actuated dogs 36 which can be extended radially outwardly to grasp the underside of an internal flange 37 on the top of each pile 24 (see Figures 6a and 6b). This arrangement permits the piles 24 to be pulled upwardly by the cylinder 26.

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At the bottom end of each pile guide 18 is an array of latch mechanisms 38 by which the template 12 is secured to the carrier 10. As best shown in Figures 8 and 9, each latch 38 includes a pivotable retainer 39 that hooks under and engages a downwardly-facing annular shoulder 40 on the top of the template 12. The retainer 39 is normally held in engagement with the shoulder 40 by a vertically slidable locking ring 42 that encircles the carrier 10 (Figure 8). In this way, the annular bottom end 44 of each pile guide 18 is held in a position in which it is snugly received internally by the slightly larger top end 46 of a corresponding collar 48 that is part of the template 12.

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When it is desired to disengage the carrier 10 from the template 12, the locking rings 42 are pulled upwardly away from the bottom ends 44 of

the pile guides 18 by a plurality of small hydraulic latch cylinders 47. The retainers 39 can then pivot, moving their lower ends radially outwardly to disengage the shoulders 40.

5 The template 12 (best shown in Figures 5 and 11) includes four of the collars 48, each aligned with one of the pile guides 18. These collars 48 form the four corners of the template 12, which has about the same cross-sectional size as the carrier 10 but has a very low profile in relation to the size of its base. A plurality of cross pieces and braces 50 connect the
10 collars 48. The stab-in guide 23 projects through an aperture 51 at the centre of the template 12.

 The use of the carrier 10 to anchor the template 12 will now be explained. The pile guides 18 of the carrier 10 are loaded with the piles 24
15 at a dock, the piles being inserted from the bottom ends 44 of the guides while the carrier floats horizontally with its ballast tanks 20 empty. The template 12 is secured to the carrier 10 by the latches 38.

 Once the commencement of a suitable weather window is identified,
20 the carrier 10 and template 12 are towed to the selected site by a ship 52. Upon reaching the site, the ends of the ballast tanks 20 nearest the bottom of the carrier are filled with water, causing the carrier to move toward a vertical position while controlled by a crane 54 on the deck of the ship 52 (as shown in phantom lines in Figure 2). The ballast tanks 20 are then filled
25 further to achieve negative buoyancy and the carrier 10 and template 12 are lowered by the crane 54 (Figure 3). A mooring line 56 previously connected to the template 12 at the surface is paid out, while the template is prevented from rotating by actuating the thrusters 22.

30 Finally, the carrier 10 and template 12 come to rest on the ocean floor with the carrier atop the template in a vertical position. The stab-in guide 23 penetrates the ocean floor to stabilize and position the carrier 10 and the template 12 (Figure 4).

35 It is then time to drive the piles 24 downwardly through the collars 48 of the template 12. The cylinders 26 are secured to the pile guides by the top slip mechanisms 28 to prevent upward axial movement. If the template

12 rests on uneven terrain and the carrier 10 is inclined to one side, the apparatus is levelled by actuating one or more of the jacking cylinders 26 to produce an unbalanced reaction load while driving the corresponding piles 24 only a short distance. The slips 35 at the bottom ends of the rods 27 of the
5 unactuated cylinders 26 are used to prevent the portion of the template 12 corresponding to those cylinders from rising.

Thereafter the piles are driven in diagonally opposite pairs, producing symmetrical and balanced reaction forces. The selected pairs of cylinders
10 26 is extended a full stroke, moving from the position of Figure 6a to the position of Figure 6b and jacking the piles 24 deeper into the ocean floor. The cylinders 26 are contracted, and the process is repeated. Thus, the cylinders 26 chase the piles 24 along the guides 18 as the piles are driven until full penetration is achieved (as best shown in Figure 4). If desired, the
15 operation of the cylinders 26 can be reversed so that contraction of the cylinders tends to pull the piles 24 upwardly. The top slip mechanisms 29 prevent the cylinders 26 from rising within the pile guides 18. The piles 24 are pulled upwardly only a short distance by the dogs 36 and flange 37 to pull the template 12 downwardly into the mud of the ocean floor. By thus
20 setting the template 12 in the mud, greater resistance to lateral template movement is achieved.

Once the driving of the piles 24 and the setting of the template 12 has been completed, the latches 36 disengage the carrier 10 from the
25 template 12 and the ballast tanks 20 are emptied. The carrier 10 is raised under the control of the crane 54, leaving the template 12 behind. The template 12 is grouted to the top ends of the piles 24 and thus permanently secured to the ocean floor and the mooring line can be attached at the surface. The carrier 10 is then ready to be used again.

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It is also possible, to reload the carrier 10 of Figures 1 to 7 for repeated use with a single template. An exemplary template 64 suitable for such an operation is shown in Figures 12 to 15. It is similar to the first described template 12 except that it has an octagonal outline as dictated by
35 the inclusion of eight collars 66 arranged in a circle. Each collar is partially supported by a radial strut 68 extending from an annular centre member 70 that receives the stab-in guide 23.

The template 64 is transported to the site and positioned on the ocean floor in the same manner as the four collar template 12. When the square carrier 10 is secured to the octagonal template 64 by the latches 36, the four pile guides 18 line up with alternate collars 66 as shown in Figure 14. Piles 72 that have previously been loaded into the carrier 10 are then jacked downwardly through the four aligned collars 66. Next the carrier 10 is lifted by the crane 54, after the ballast tanks 20 have been partially emptied, and reloaded with four additional piles 24. The carrier 10 is lowered and, with the aid of the thrusters 22, aligned with the unused collars 66, as shown in Figure 15. Insertion of the stab-in guide 23 in the apertured centre member 70 helps to align the carrier 10 accurately. After securing the carrier to the template 64 with the latch mechanisms 36, a second set of piles (not shown) is driven in the same manner as the first set. Once all the piles have been driven, the template 64 can be left in place as a permanent structure. Alternatively, it can serve a temporary function during the pile placement operation, to be removed later.

Another example of repeated use of the carrier 10 with respect to a single structure to be anchored is best understood with reference to Figures 16 and 17. A template 73 includes a square centre section 74 to which a smaller square anchoring section 76 is attached at each of four corners. Each anchoring section 76 is similar to the first described template 12, having four pile receiving collars 80 and a tubular centre member 82 that receives the stab-in guide 23. This template 73, being anchored by sixteen piles, is best suited for withstanding high loads, as would be encountered with respect to a floating oil or gas well platform.

The relatively large template 73 is transported to the site independently of the carrier 10 and lowered to the ocean floor. Then the carrier 10, loaded with four piles (not shown) is positioned above one anchoring section 76 of the template 73, as shown on the left in Figure 17, and latched to that anchoring section, as shown in phantom lines on the right. After the piles have been driven in the manner described above, the carrier 10 is raised, reloaded, and lowered to drive four more piles for anchoring another section 76.

When an unusually large template 73 of the construction shown separately in Figure 16 is used, it may be desirable to employ a different technique in which a plurality of carriers 10 are used simultaneously. In such a technique, first the template 73 is sunk partway toward the ocean floor and suspended in a submerged position beneath a derrick barge 84 (Figures 22 and 23) and then the template 73 is sunk further, but not to the bottom, and the carriers are positioned partially under water and partially above water and above the template and in alignment with the collars 80. The carriers 10 are latched to the template 73 and the entire apparatus is lowered to the ocean floor by the barge 84 with the carriers being used for floatation to reduce the load on the barge. After the piles (not shown) have been driven hydraulically, the carriers 10 are released from the template and raised (Figure 24) to be used again. The ballast tanks 20 of the carriers 10 can be used to control the buoyancy of the carrier/template combination during lowering and positioning of the combination, and to assist in raising of the carriers.

In the variant illustrated in Figure 18, a template 88 is used which is similar to the template 12 of Figures 5 and 11, except that, on one side of the template 88 the collars 48a are set at an angle. The piles 90a thus extend radially away from the template 88 at their bottom ends 92.

The pile guides 93a and 93b of the carrier 86 are mounted externally on two end frames 94 and 96 that tie the ballast tanks 20 together. Two of the guides 93a are angled to align the piles 90a they contain with the angled collars 48a. If desired, the angular orientation of all the guides 90a and 90b can be made adjustable so that the carrier 86 is adaptable for use with a variety of differently constructed templates. In other respects, the carrier 86 and template 88 are the same as the carrier 10 and template 12 first described above.

A further embodiment of the invention is illustrated in Figures 19 to 21. Here, a carrier 98 is intended for use without a template. Instead, a single pile 100 to which a mooring line 102 is attached constitutes the entire structure to be anchored.

The carrier 98 is generally similar to the first described carrier 10, having a plurality of parallel tubular ballast tanks 104 tied together by a frame 106. However, the carrier 98 has only a single pile guide 108 that extends downwardly through its centre parallel to the tanks 104. This pile
5 guide 108 contains a hydraulic jacking cylinder (not shown) similar to the jacking cylinder 26 described above and operated by a power plant 109 at the top of the carrier 98. As in the case of the carriers described above, an impact hammer can be used instead of the jacking cylinder, although the use of a jacking cylinder is preferred. Four stab-in guides 110 are included, one
10 projecting downwardly at each corner of the carrier 98.

When the carrier 98 is lowered by a cable 112, the stab-in guides 110 penetrate the ocean floor under the weight of the carrier with full tanks 104. Then the pile 100 is jacked step-by-step into the ocean floor in the
15 manner described above, the mooring line 102 having been attached at the surface. The tanks 104 are emptied and the carrier 98 is raised. The primary purposes of the apparatus in this application are to (1) position, (2) orient, (3) plumb, and (4) stabilize the pile during driving.

20 It will be appreciated from the foregoing that there is provided a greatly improved method and apparatus for anchoring off-shore structures. A reusable carrier is employed by which piles can be transported, positioned and driven with accuracy and efficiency. The carrier can also be used to transport and position a template or other structure to be anchored
25 by the piles.

CLAIMS

1. A method of driving a pile into the ocean floor comprising the steps
5 of: loading said pile into a floatable carrier; towing said carrier to a
selected off-shore location; causing said carrier to sink to the ocean floor;
causing a driving mechanism mounted on said carrier to drive said pile into
the ocean floor by repeatedly expanding and contracting a hydraulic
cylinder; and raising said carrier without said pile.
10
2. A method according to claim 1 including the further step of setting
said template in the ocean floor to resist lateral forces by contracting said
cylinders.
- 15 3. A method according to claim 2 wherein said cylinder is caused to
chase said pile, moving along said carrier as said pile is driven into the
ocean floor.
4. A method according to claim 1 wherein said carrier is caused to sink
20 by filling ballast tanks with water.
5. A method according to claim 4 wherein said carrier is an elongated
structure in which said pile is loaded axially, said carrier being towed in a
horizontal position and then being caused to assume a vertical orientation as
25 it sinks.
6. A method according to claim 1 comprising the further step of causing
at least one stab-in guide on the bottom end of said carrier to penetrate the
ocean floor, thereby positioning and stabilizing said carrier prior to driving
30 said pile.
7. A method of anchoring a structure to the ocean floor, comprising the
steps of: loading at least one pile into a floatable carrier; securing the
structure to be anchored to the bottom end of said carrier; towing said
35 carrier and said structure to a selected off-shore location; causing said
carrier to sink bottom end first to the ocean floor so that said carrier comes
to rest on said structure; causing a driving mechanism mounted on said

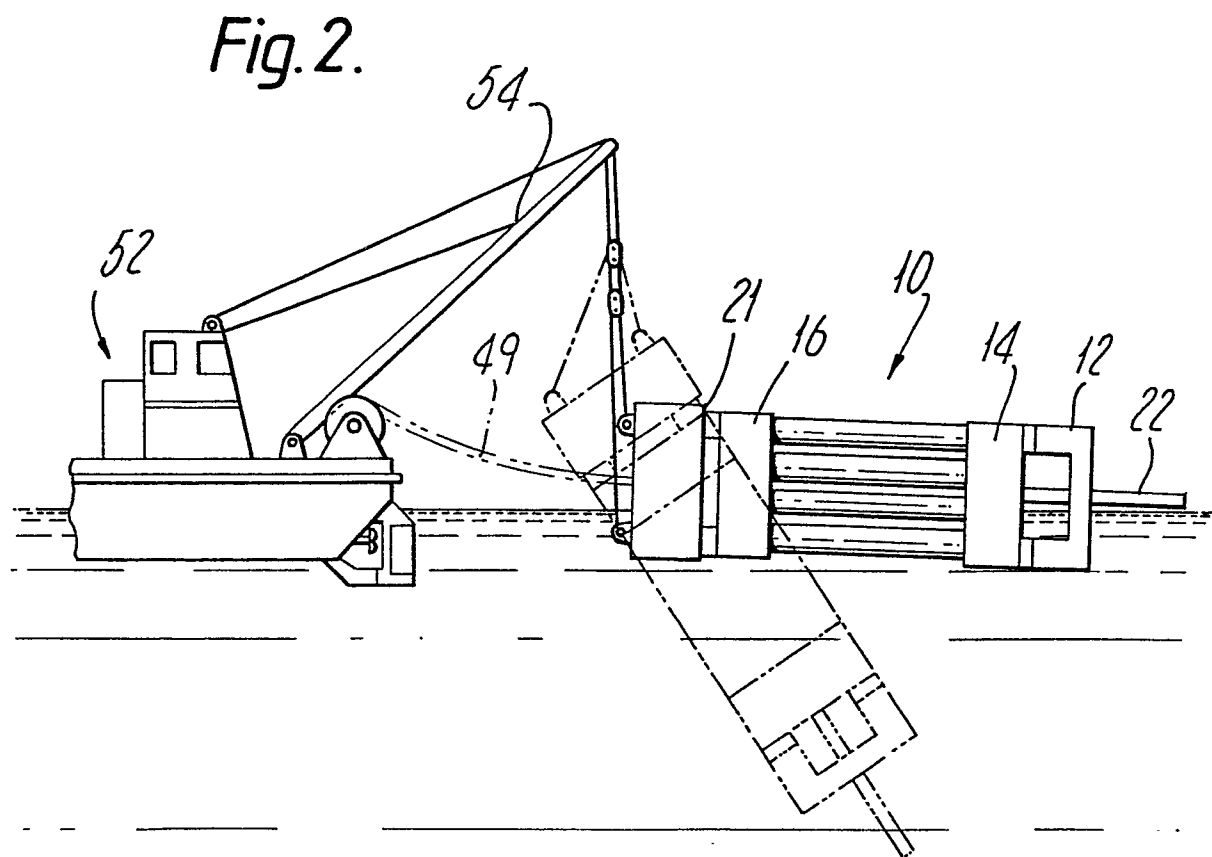
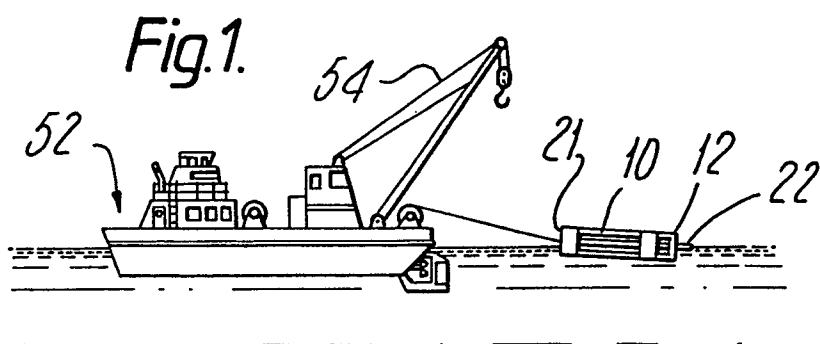
carrier to drive said pile through said structure into the ocean floor by repeatedly expanding and contracting a hydraulic cylinder; releasing said structure from said carrier; and raising said carrier.

5 8. A method according to claim 7 wherein a plurality of piles are loaded into said carrier, said piles being driven at least two at a time to apply a balanced reaction load to said carrier.

10 9. A method according to claim 8 further comprising the steps of selectively driving said piles so as to apply an unbalanced reaction force to said carrier and thereby levelling said structure prior to driving said piles so as to apply a balanced reaction force.

15 10. A carrier for use in anchoring a structure to the ocean floor, said carrier comprising: at least one pile guide adapted to receive a pile for use in anchoring said structure; drive means for driving said pile along said pile guide into the ocean floor, said drive means comprising an expandable hydraulic cylinder disposed in said pile guide and slip means for securing said cylinder to said guide to apply a reaction force to said carrier as said pile is
20 driven; and ballast tank means for selectively causing said carrier to float in a horizontal position or sink in a vertical position.

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Fig. 3.

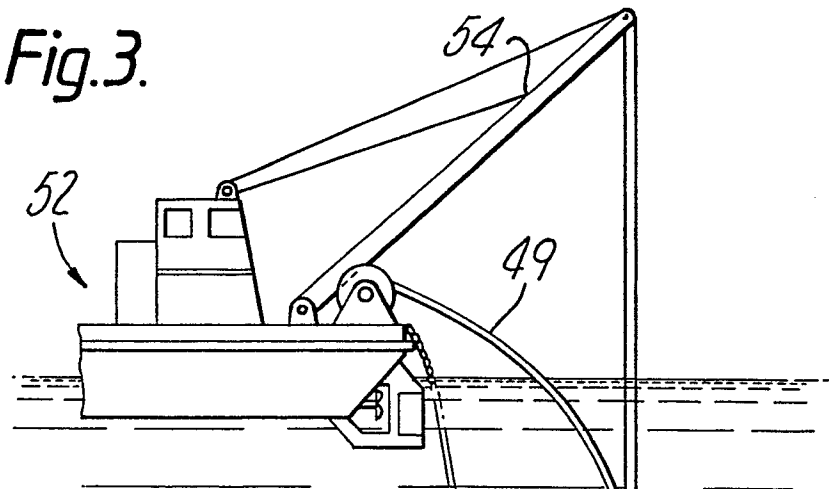
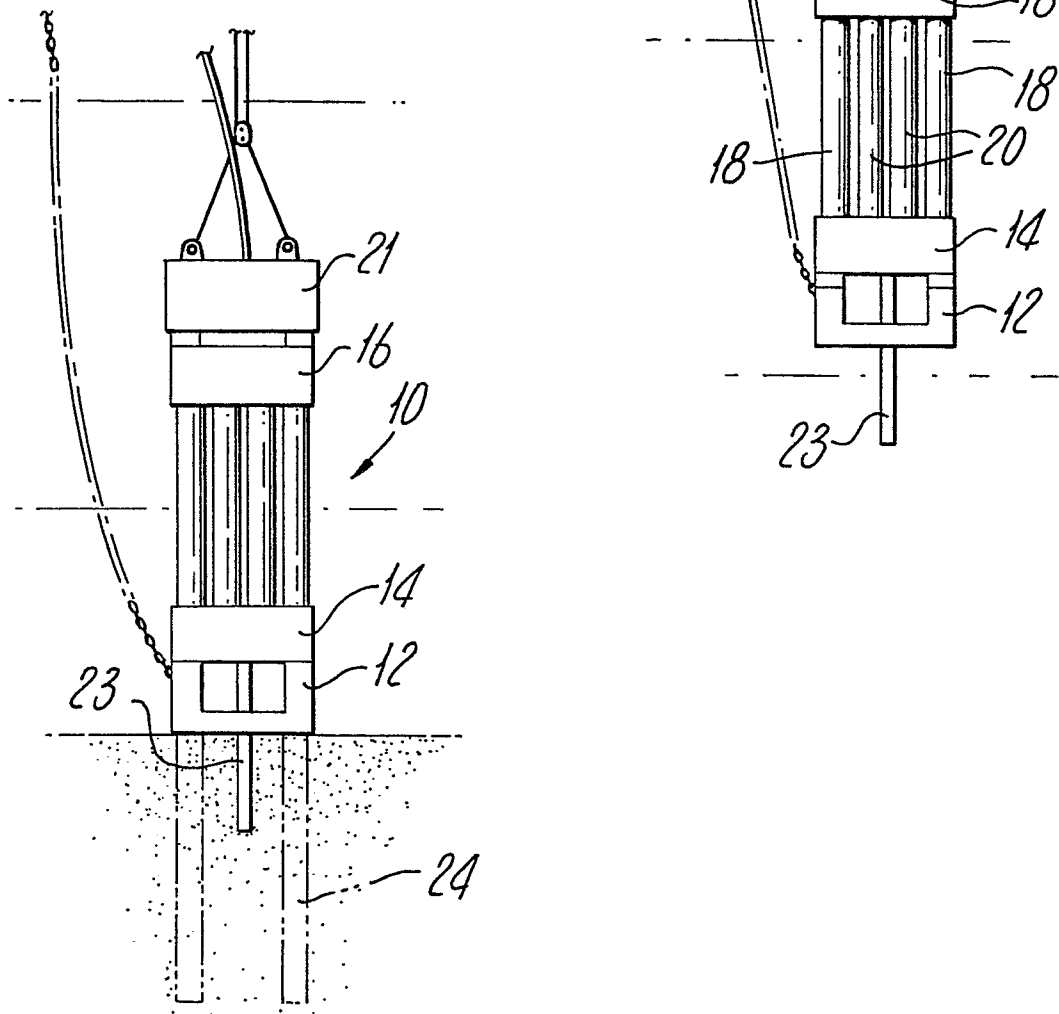


Fig. 4.



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Fig. 5.

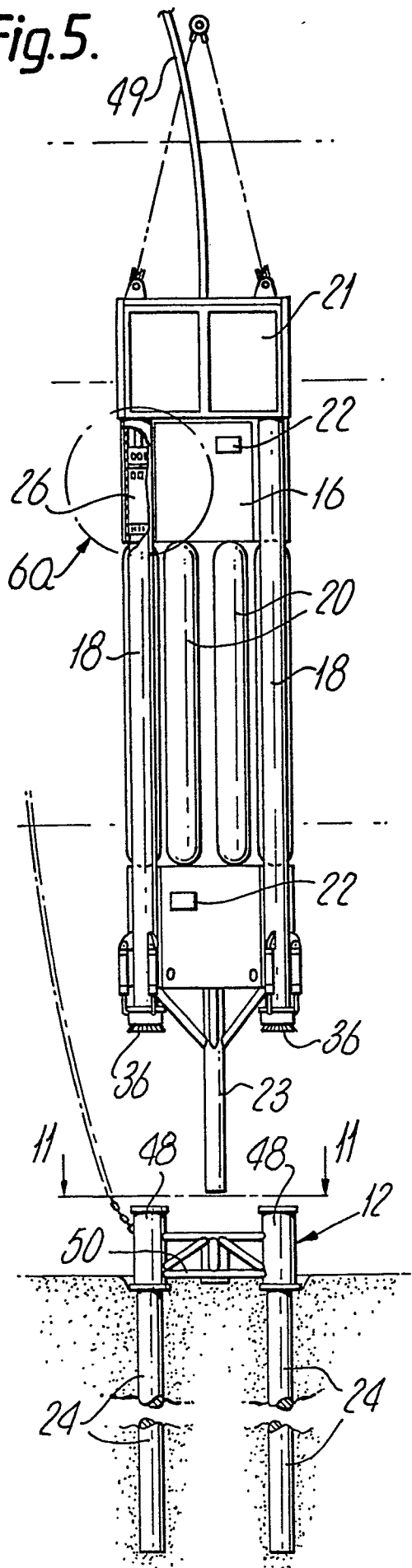


Fig. 6a.

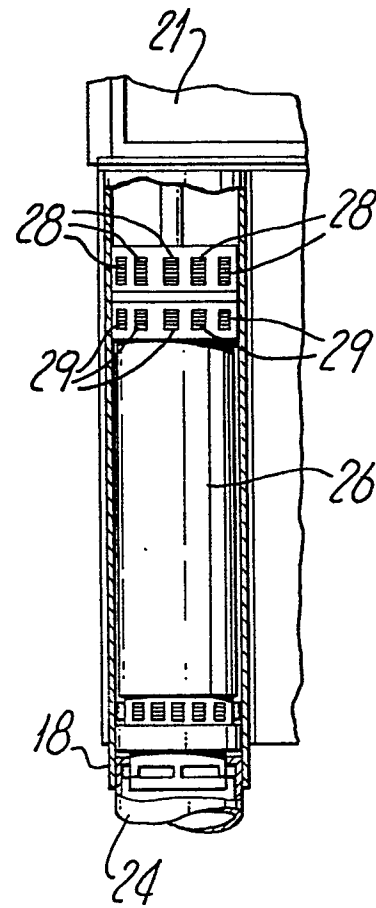


Fig. 6b.

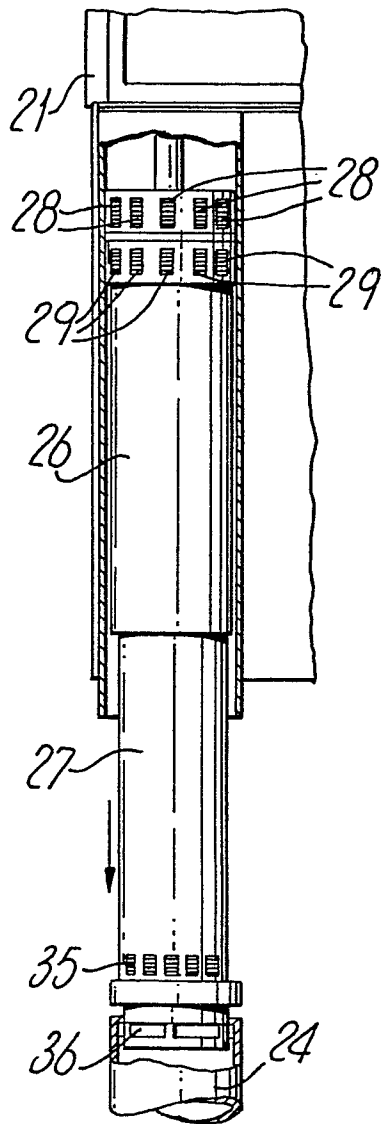


Fig. 7.

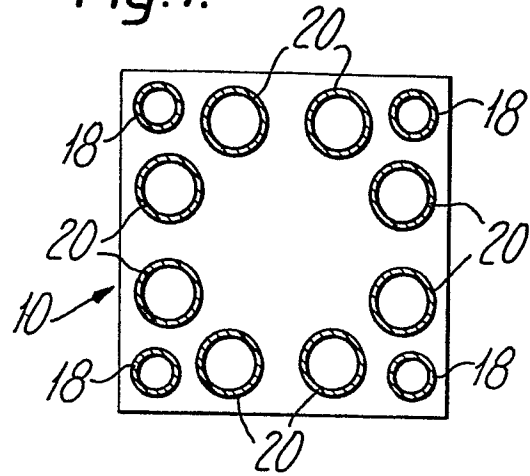


Fig. 8.

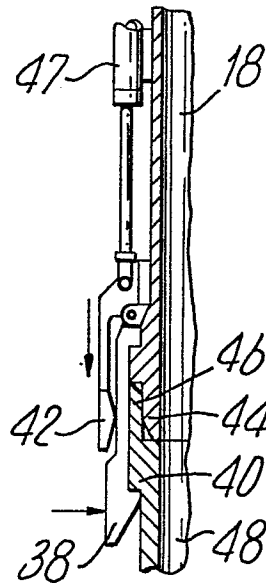


Fig. 9.

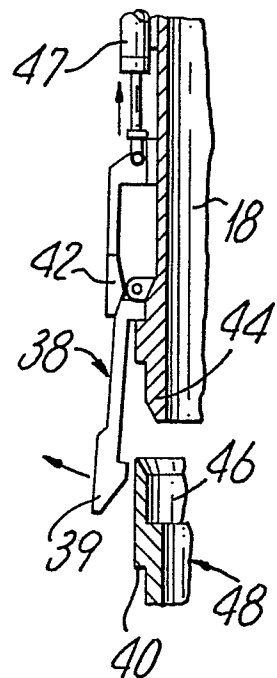


Fig 10

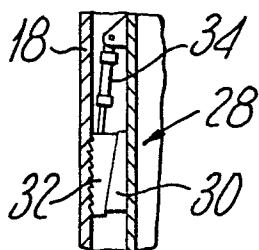
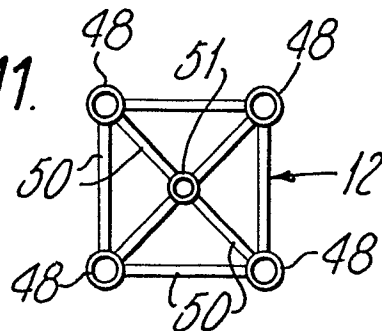


Fig. 11.



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Fig.12.

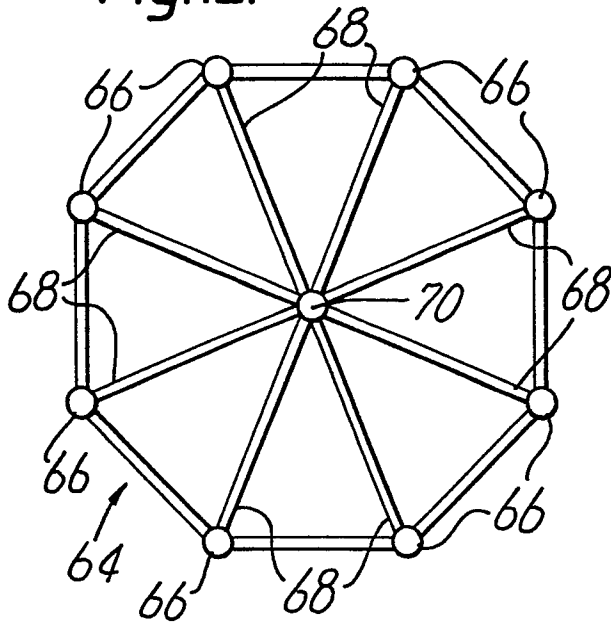


Fig.13.

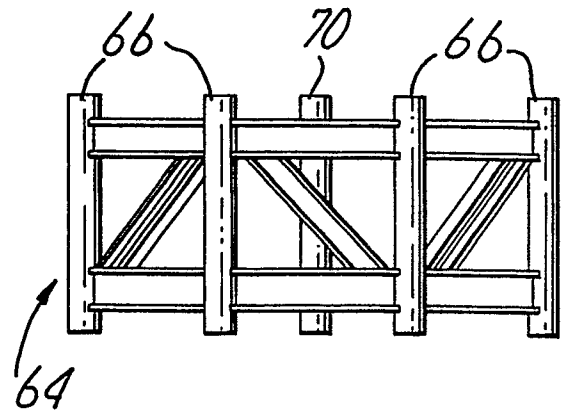


Fig.14.

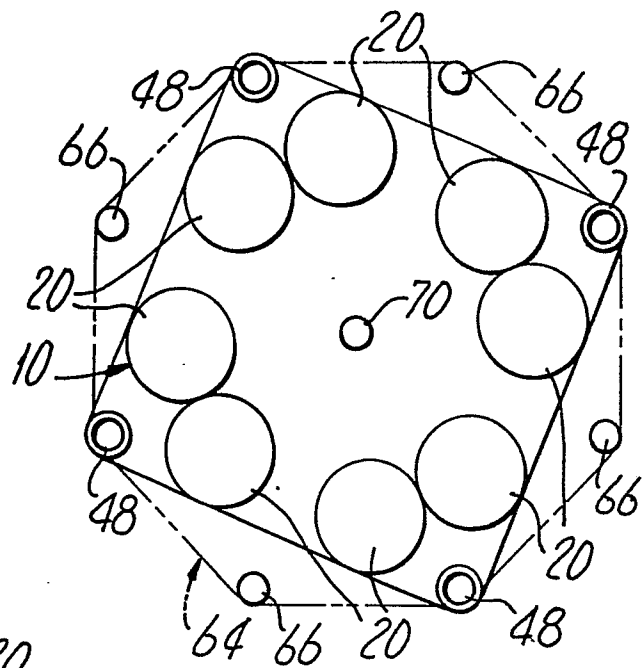
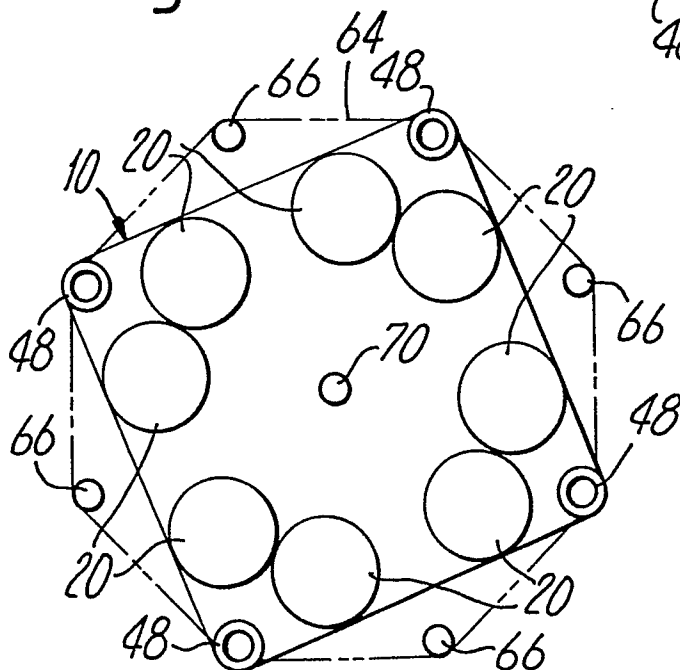


Fig.15.



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Fig.16.

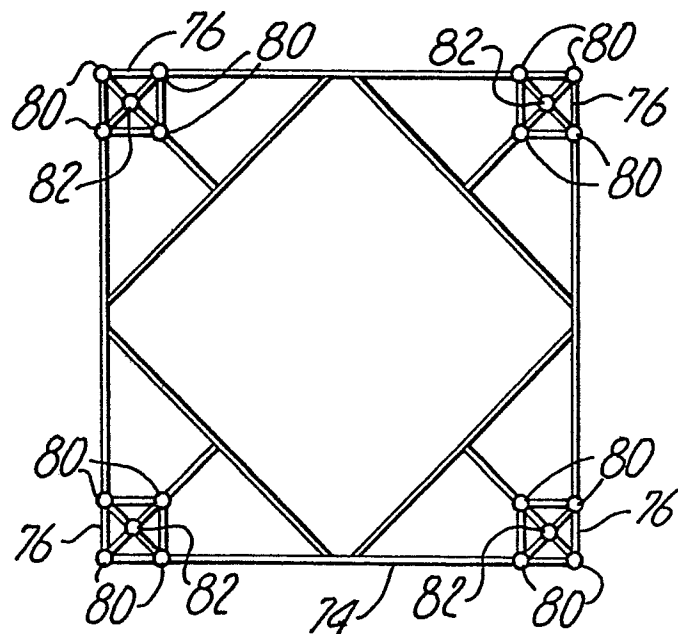
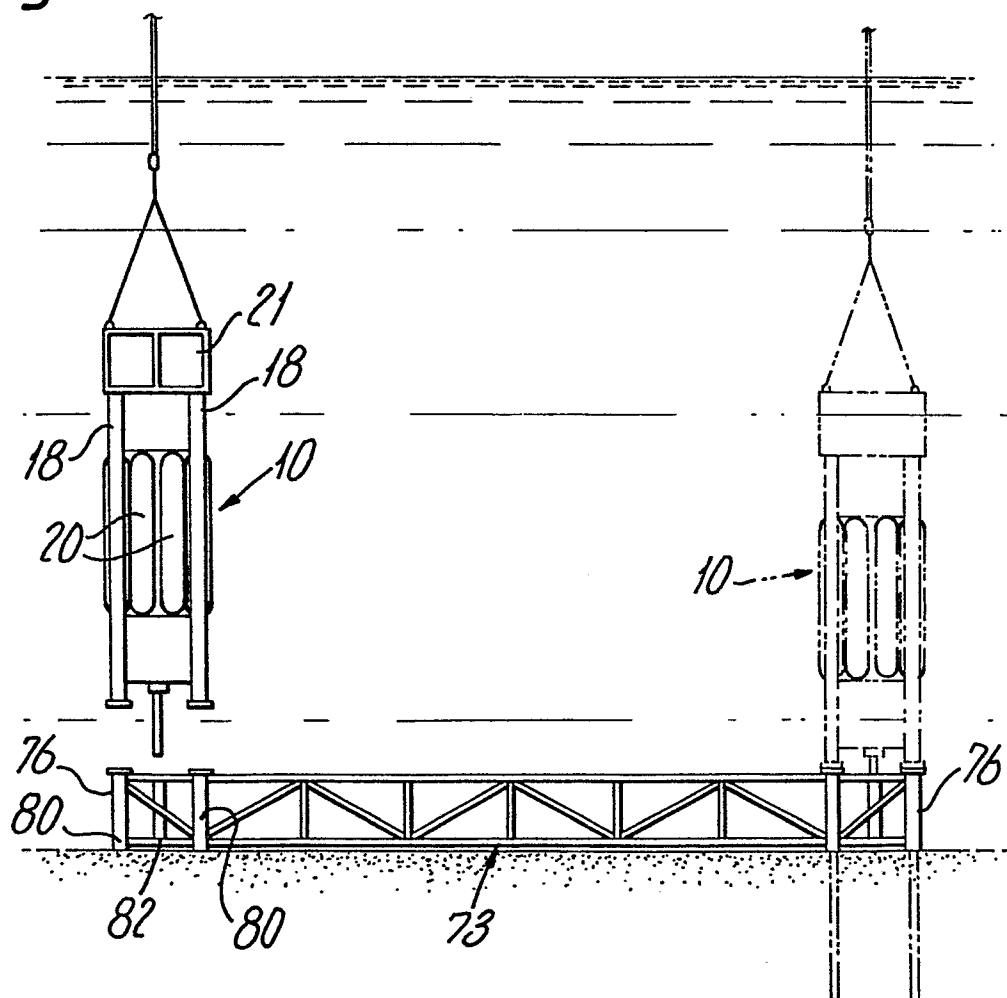


Fig.17.



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Fig.18.

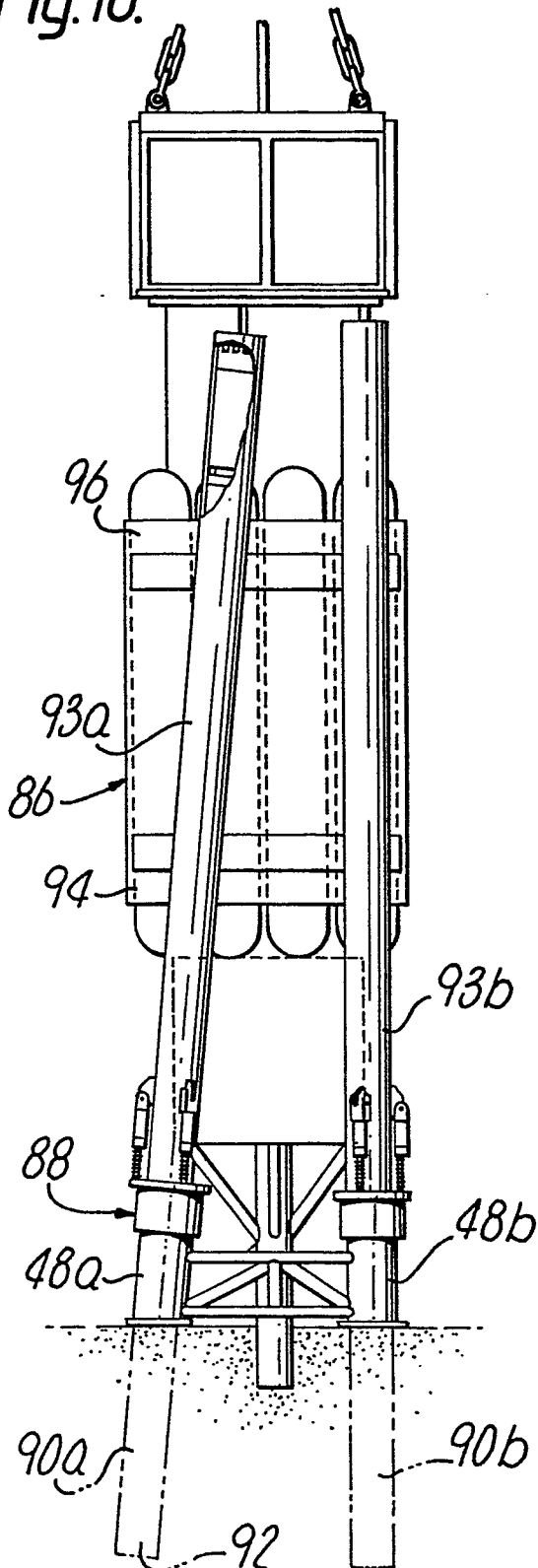


Fig.19.

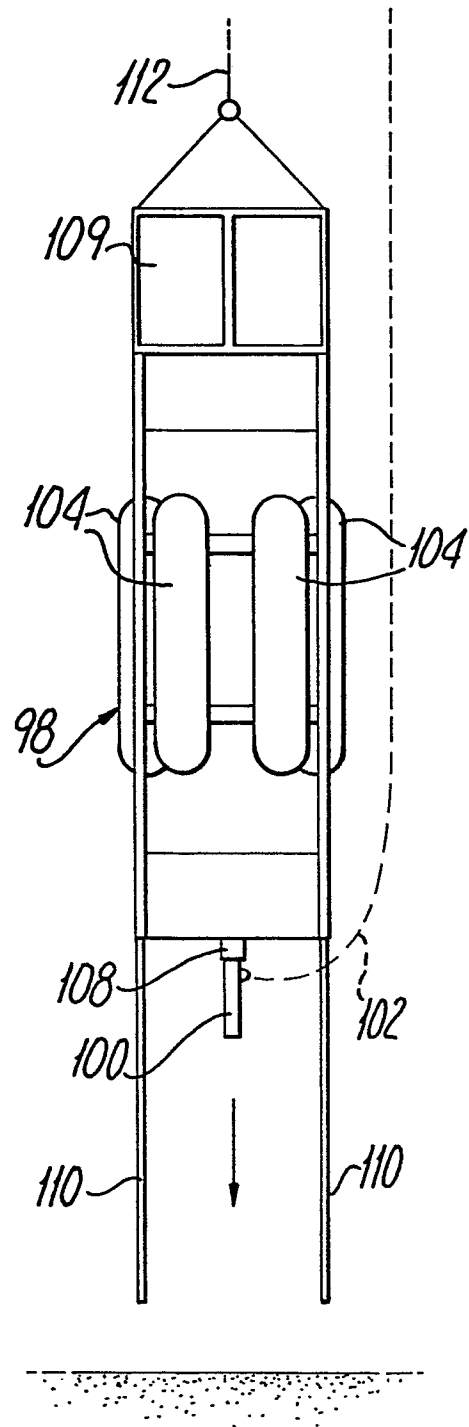
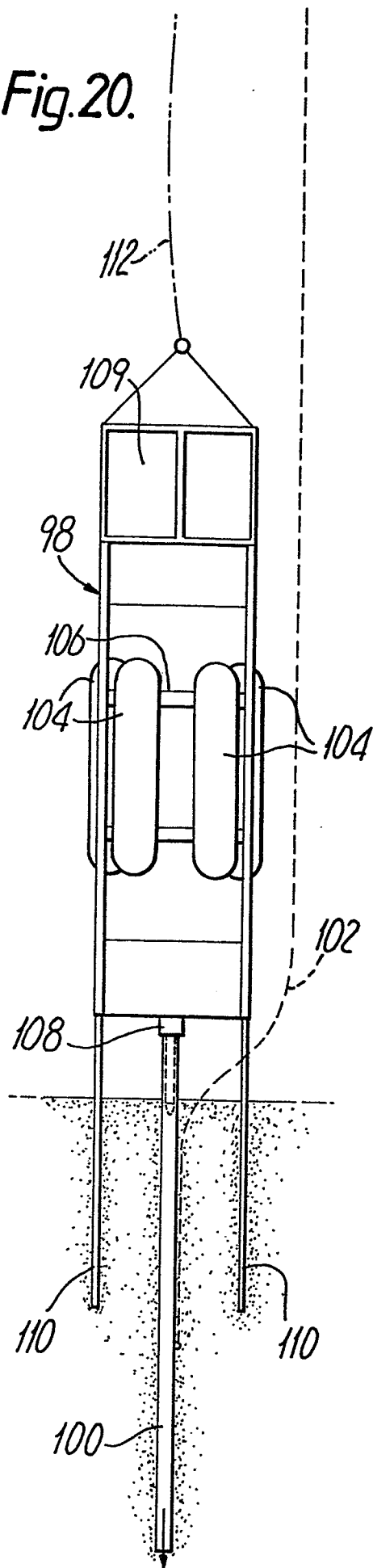
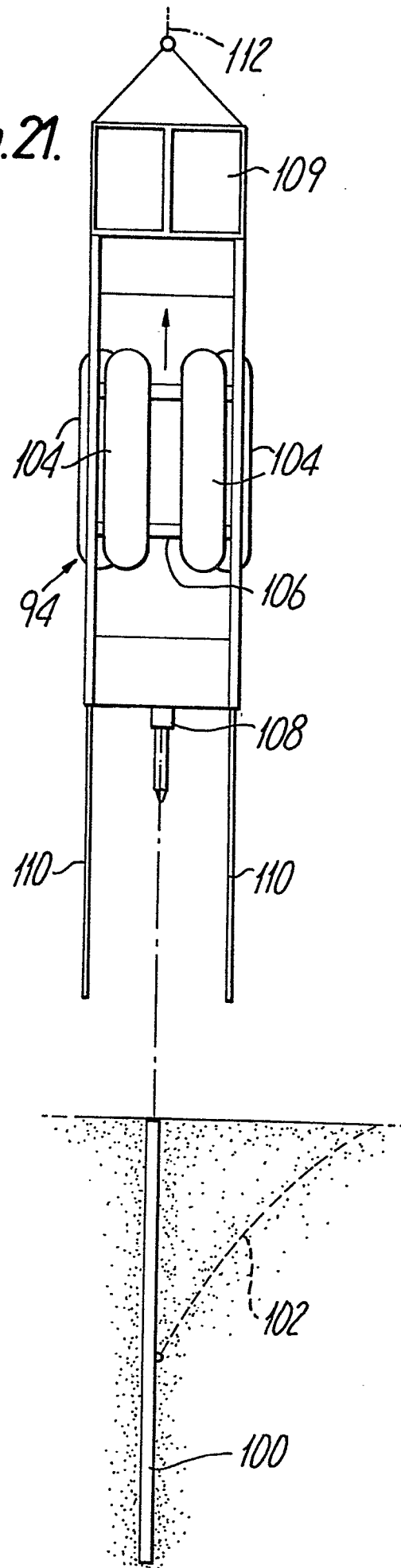


Fig. 20.



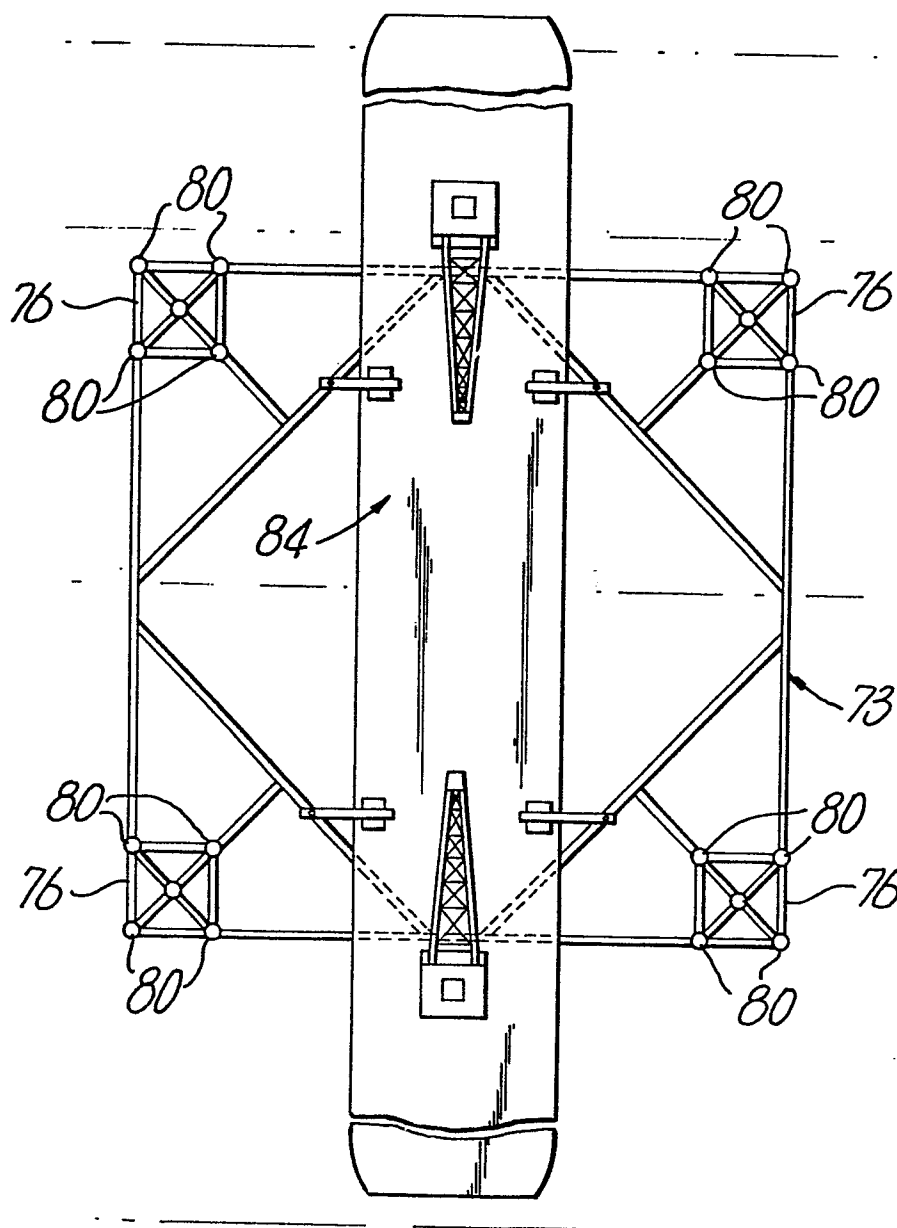
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Fig. 21.



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Fig. 22.



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Fig.23.

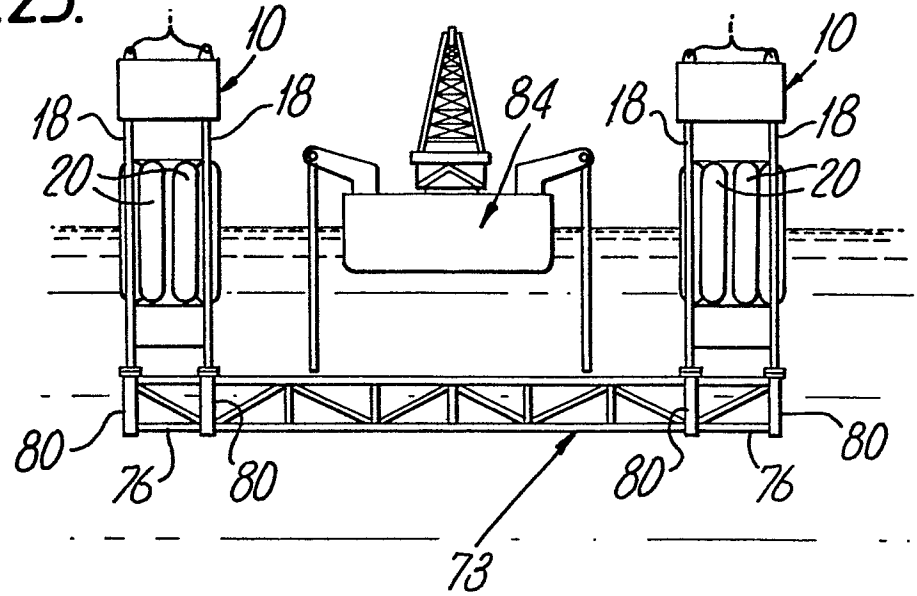
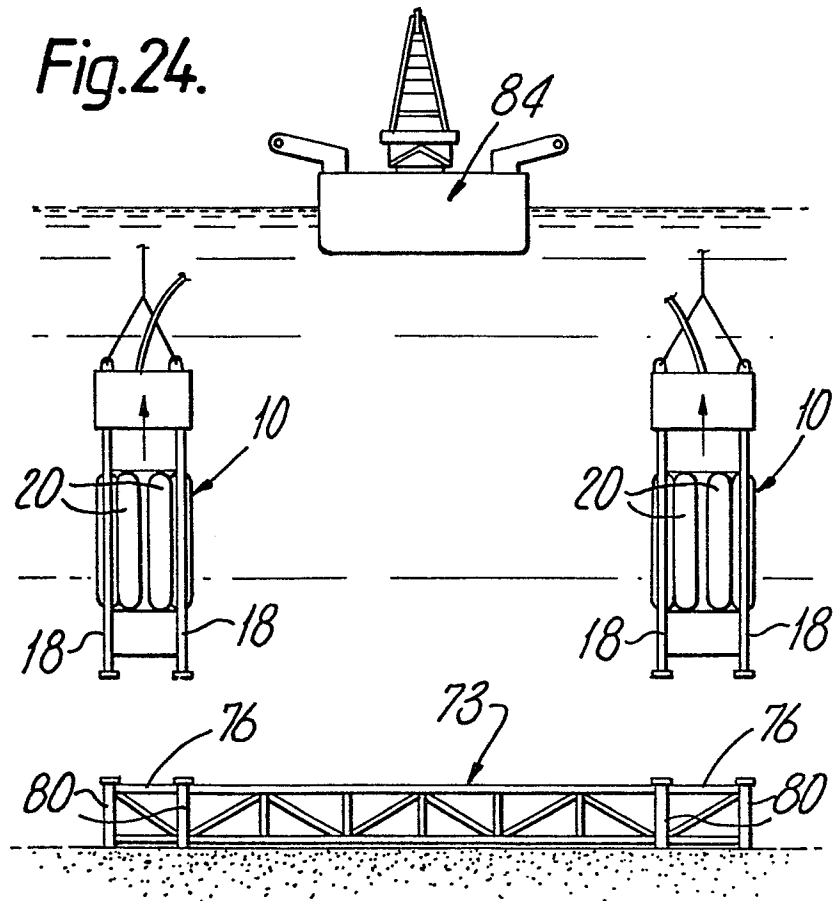


Fig.24.





European Patent
Office

EUROPEAN SEARCH REPORT

0059648

Application number

EP 82 30 1086

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	GB-A-1 511 829 (TAYLOR WOODROW) *Page 1, lines 19-50, 69-94; page 2, lines 1-8, 41-71; figures 1, 4A to 4E*	1, 2, 3, 7, 8	E 02 D 29/06 E 02 D 7/00 E 02 D 27/50 E 02 B 17/02
Y	FR-A-2 423 592 (E.M.H) *Page 2, lines 10-30; page 3, lines 22-35; page 4, lines 29-37; page 5, lines 1-10; page 6, lines 11-19; page 7, lines 6-11, 14-24, 33-37; page 8, lines 1-2, 13-31; page 9, lines 1-7; figures 1, 2, 3, 6, 7*	1, 2, 3, 4, 7, 8, 9, 10	
Y	US-A-4 045 969 (JANSZ) *Column 3, lines 21-36; column 4, lines 1-13; figures 1 to 4*	1, 3	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	US-A-3 998 064 (JANSZ) *Column 2, lines 64-68; column 3, lines 1-2, 12-18, 28-32; figures 1 to 5*	1	E 02 D E 02 B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11-06-1982	Examiner RUYMBEKE L.G.M.
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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