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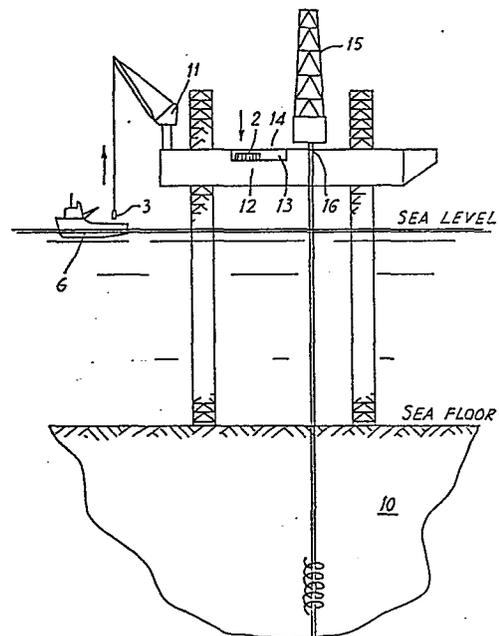
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54 **Offshore waste disposal.**

57 A method according to the invention comprises drilling at least one bore hole 16 from a bottom-supported drilling platform 12 at an offshore site, temporarily storing units 2 of waste material 40 on the platform, transferring the units from storage 13 to the head of a bored hole, disposing units one upon another in the bore hole and sealing the hole to contain the waste materials below the seabed.



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OFFSHORE WASTE DISPOSAL

The present invention relates to the offshore disposal of waste materials, especially noxious waste materials such as toxic or nuclear wastes. The dumping of waste into the sea, for example from a ship, is not generally acceptable to the public as a method of waste disposal.

The present invention provides a method of disposing of waste materials which comprises

drilling at least one bore hole from a bottom-supported drilling platform at an offshore site, transferring units of waste material from storage to the head of a bored hole, disposing units one upon another in the bore hole and sealing the hole to contain the waste materials below the seabed.

The method preferably comprises

drilling at least one bore hole from a bottom-supported drilling platform at an offshore site, temporarily storing units of waste material on the platform, transferring the units from storage to the head of a bored hole, disposing units one upon another in the bore hole and sealing the hole to contain the waste materials below the seabed.

The present invention also provides apparatus for use in the latter method, comprising

a bottom-supported drilling platform having drilling equipment including a drilling derrick, storage facilities for units of waste materials and means for transferring the units from storage to the head of a bored disposal hole.

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A method according to the invention is particularly suitable for offshore waters up to 150 m in depth using a jack-up drilling platform. Preferably the disposal bore hole should be at least 1000 m in depth below the seabed (e.g. about 1500 m). Preferably the diameter of the bore should be at least 50 cm (e.g. about 60 cm to 1 m) and most preferably the bore should be cased over at least a majority of its length to prevent internal obstruction or collapse.

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Geographical areas particularly suitable for application of a method of waste disposal according to the invention are those where no hydrocarbon resources are present at any depth, and most especially those areas having several impermeable subterranean layers without faults.

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The units of waste material are suitably of comparable diameter to the standard drill sizes used in offshore drilling procedures e.g. they could be cylindrical in shape and from about 25 cm to about 1 m in diameter and about 1m to 5m in length.

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Individual units may be lowered into a hole at the end of a wire or cable, or may be

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allowed to slide down a hole under the influence of their own weight and impeded by the hydrodynamic resistance of fluid displaced from the hole.

Alternatively, a plurality of units may be lowered
5 into a bore hole together in a string.

Preferably the units are in the form of canisters or sealed pipe lengths filled with waste material. It is preferred that the waste materials be sealed into suitable canisters or pipe lengths
10 before transport to the disposal site.

Storage of the units on the platform may be at deck level or may be below deck. Access to a below deck storage bay may suitably be through the deck floor from above; such a bay may be
15 provided with a sliding cover.

It is preferable that units be transported to and/or from the platform in groups (e.g. 4, 6, 8 or 9) in compartmentalised containers each having a protective cell for each unit. Where the waste
20 material is radioactive it is preferable that any, most preferably each, of the units, containers and storage facilities are shielded to prevent radiation leakage. Each container for a group of units may be
25 of a size suitable for transport by conventional road or rail haulage.

Units of waste material may be transferred from storage to a bore hole by any mechanical means e.g. conveyor, crane, robotic arm, etc.

5 The invention will now be described in detail, by way of example only, with reference to

Figures 1 to 9 of the drawings in which like numerals represent like structures and :

10 Figure 1 is a representation of a shielded waste container for use within the method of the invention;

Figure 2 is a schematic representation of a method of offshore waste disposal according to the invention;

15 Figure 3 is a representation of a drilling platform for use within the method of the invention;

Figure 4 is a representation of the Figure 3 platform during waste emplacement;

Figure 5 is a representation of apparatus for handling waste within the method of the invention;

20 Figure 6 is a representation of the Figure 3 platform showing the final encapsulation of waste;

Figure 7 is a representation of a means for waste emplacement within the method of the invention; and

25 Figures 8 and 9 are representations of further means for waste emplacement within the method of the invention.

As shown in Figures 1 and 2, at the site of origin (1) radioactive waste is sealed in pipe lengths e.g. steel drill piping, and the thus formed cylinders (2) are loaded into individual protective cells in a shielded container (3) sealed by a removable lid (7). A plurality of such containers (3) are then taken by rail (4) to a convenient port (5) where they are loaded onto a ship (6).

Referring to Figure 3, at the offshore disposal site (10) the containers (3) are removed from the ship (6), e.g. by use of a crane (11) mounted on the platform deck (12), and placed in a storage bay (13) set into the platform deck. The bay (13) is radiation shielded and has a protective sliding cover (14).

The platform carries a drilling derrick (15) extending over the side of the deck. Drilling operations may be carried out whilst containers are being off-loaded from the supply ship.

Referring now to Figures 4, 5 and 6, the drilling derrick (15) may be either moveable on tracks or may be constructed so as to allow passage of a gantry crane (20) beneath it in order to allow access to the head of the bore hole (16). A gantry crane runs between the storage bay and the bore hole on tracks or skids (21) laid on the deck.

The gantry crane (20) is provided with a shielded receptacle (22) for carrying the cylinders

(2). The cover (14) of the storage bay (13) is removed, the receptacle (22) is placed over a cell in a container (3) and a cylinder (2) is drawn up into the receptacle (22). The cover (14) of the storage bay is replaced and the gantry crane (20) is moved to the head of the bore hole (16) where the cylinder

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(2) is released from the receptacle (22). The procedure is repeated to fill the bore hole with cylinders to a predetermined level. The top of the bore hole is then sealed (30), for example with concrete grouting, to contain the waste materials below the seabed.

Emptied containers (31) may be off-loaded from the platform to the supply vessel whilst cylinder disposal is in progress.

In the method of the invention described above the waste cylinders are allowed to slide down the bore under the influence of their own weight and impeded by the hydrodynamic resistance of the fluid displaced from the bore. Alternative means for emplacement of cylinders are described below, by way of example, with reference to figures 7 to 9.

In figure 7, waste material (40) (e.g. radioactive waste) in sealed canisters (2) is lowered by a derrick mounted winch into the bore (16) on the end of a line of wire or cable (41). The line may, for example, be made of steel or aromatic polyamide resin - e.g. "Kevlar" (Registered Trade Mark). In order to improve the efficiency of operation of the method according to the invention it may be advantageous to provide a jack-up rig deck-hull (12) with more than one derrick (15) (e.g. two) for controlling winching of line (41).

Thus canisters (2) may be lowered into more than one hole simultaneously.

Offshore bore-holes may be drilled from bottom supported marine drilling platforms using a drill string formed by interconnection of individual
5 standard length drill sections and having a drilling tool attached at the end; as the drill string is extended section by section the bore is drilled deeper.

10 In a method according to the invention canisters of waste material may be attached as an extension at the end of a drill string, in place of the drilling tool, for lowering into a pre-drilled bore. For example, as shown in figures 8 and 9, a number
15 of canisters may be interconnected to form a single unit of similar dimensions to a standard length drill section and attached to the string or, alternatively, a number of canisters of suitable diameter may be loaded into a tube having similar
20 dimensions to a standard length drill section and attached to the string.

In figure 8 noxious waste (40) is presealed in a protective canister (2). A number of such
canisters (2) are loaded into a casing(50) having
25 suitably sized apertures (51). A mechanical catch (52) is provided if required to hold each canister (2) in place.

Individual canisters (2) may be spaced apart by suitable diaphragms (53) within the casing (50).

Thus each casing(50) acts as a magazine for loading with a number of canisters (2). The casing (50) is of comparable dimensions to a drill section and may have a suitable means (54) for attachment to a standard drill string or cable. In this case the canisters (2) have no structural load imposed on them as they are lowered down a disposal hole (16).

In figure 9, noxious waste (40) is presealed in a protective canister (2) having complementary threaded connector means (58) at each end of the outer shell. A plurality of such canisters (2) may then be interconnected to provide sections of suitable length for attachment to a drill string. Where the waste material (40) is liable to generate heat (e.g. where the material (40) is high grade nuclear waste) spacer sections (59) may be incorporated to aid heat disipation.

In this case the canisters (2), and spacers (59) have a structural load imposed upon them as they are lowered down a disposal hole (16) and so they are reinforced to withstand both this load and the torquing of the joints.

The complete lengths for attachment to the drill string (e.g. about 10 m lengths) may be prepared either on shore or offshore on the platform

as is most convenient.

5 A number of such lengths are lowered into a disposal hole (16) at the end of a drill string and a conventional oil well tool is used to disconnect the sections containing waste canisters (2) and the drill string is withdrawn.

10 It is emphasized that suitable existing drilling rigs could be used within the scope of the invention with little or no modification, although it is of course clear that when handling e.g. extremely radioactive waste, remote handling by automatic derricks, lead protective screens, constant wash-down of deck area during operation and other protective measures might be required. Some
15 rig modification for the purposes of the invention can however be advantageous, a preferred such modification being that exemplified by figures 3 to 5.

20 A bottom-supported drilling platform is essential for the method of the invention since it provides a safe and stable base for storage and drilling. A jack-up drilling platform is particularly advantageous since it can be refloated and moved to a new offshore site when required.

25

C L A I M S :

1. A method of disposing of waste materials characterised by drilling at least one bore hole (16) from a bottom-supported drilling platform (12) at an offshore site (10), transferring units (2) of waste material (40) from the platform to the head (16) of the bored hole, disposing units one upon another in the bore hole and sealing (30) the hole to contain the waste materials below the seabed.
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- 10 2. A method according to claim 1 characterised by drilling at least one bore hole (16) from a bottom-supported drilling platform (12) at an offshore site (10), temporarily storing units (2) of waste material (40) on the platform, transferring the units from storage to the head (16) of a bored hole, disposing units one upon another in the bore hole and sealing (30) the hole to contain the waste materials below the seabed.
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- 20 3. A method according to claim 1 wherein the bottom-supported platform (12) is a jack-up platform.

4. A method according to claim 1 wherein the units (2) of waste material (40) are allowed to slide down the bored hole under their own weight
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against the hydrodynamic resistance of fluid displaced from the hole.

5. A method according to claim 1 wherein
5 individual units (2) of waste material (40) are lowered into the bored hole on a line (41).

6. A method according to claim 1 wherein a
10 plurality of units (2) of waste material (40) are lowered into the bored hole together in a string.

7. A method according to claim 1 wherein
15 each unit (2) of waste material (40) is in the form of a canister or sealed pipe length filled with the waste material.

8. A method according to claim 1 wherein
20 a gantry crane (20) is movable across the platform deck (12) between a storage bay (13) for the units (2) of waste material (40) and the head (16) of the bored hole for collection of the units from storage and depositing them down the bored hole.

9. A method according to claim 8, wherein
25 the platform (12) carries a gantry crane (20) movable between a storage bay (13) for the units (2) of waste

material (40) and a position below a derrick (15)
for collection of the units and depositing them in
the bored hole or holes.

5 10. Apparatus for use in the method of claim 1
 comprising a bottom-supported drilling platform (12)
 having drilling equipment including a drilling derrick
 (15), storage facilities (13) for units (2) of waste
 materials (40) and means (20) for transferring the
10 units from storage to the head of a bored disposal
 hole.

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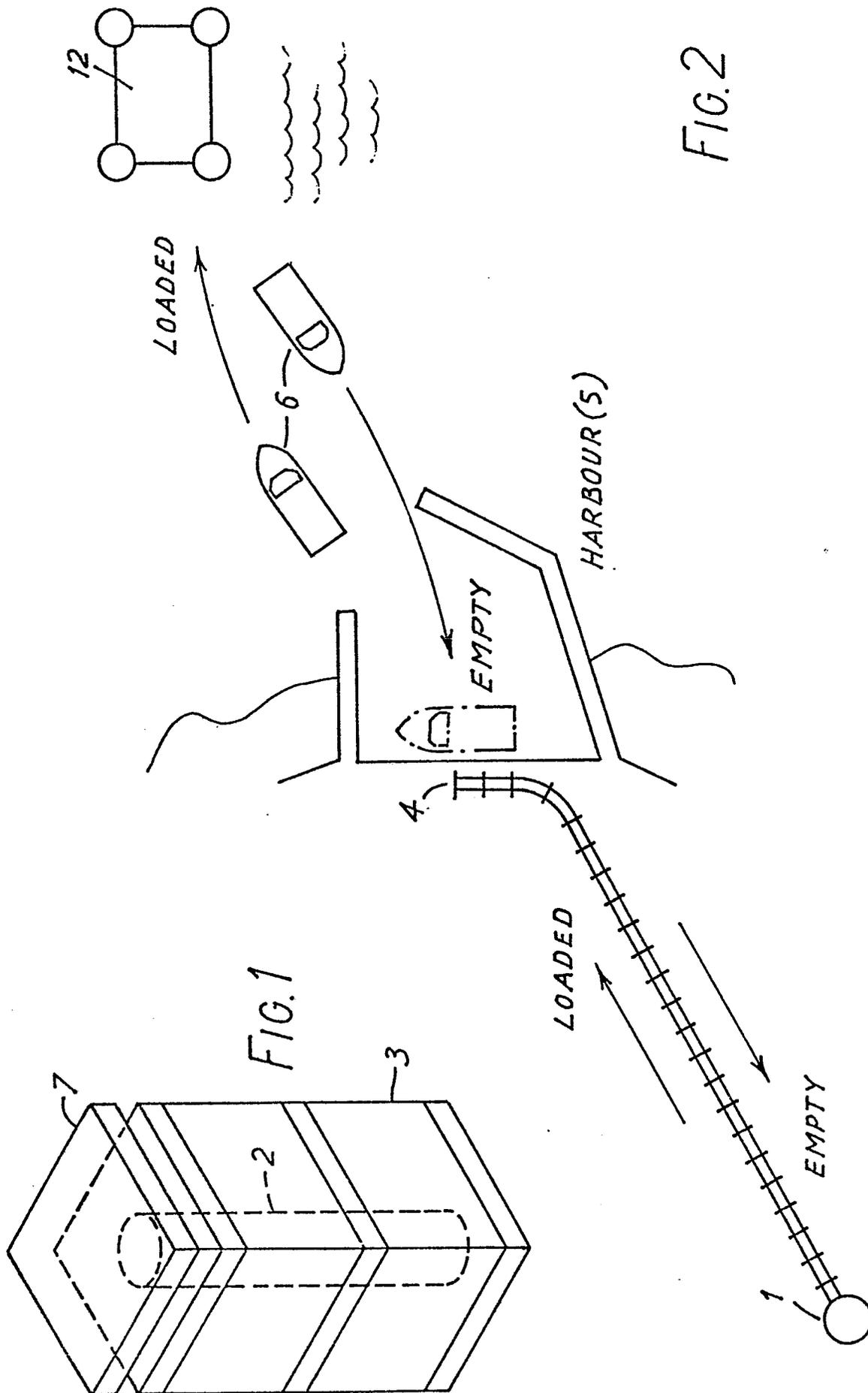
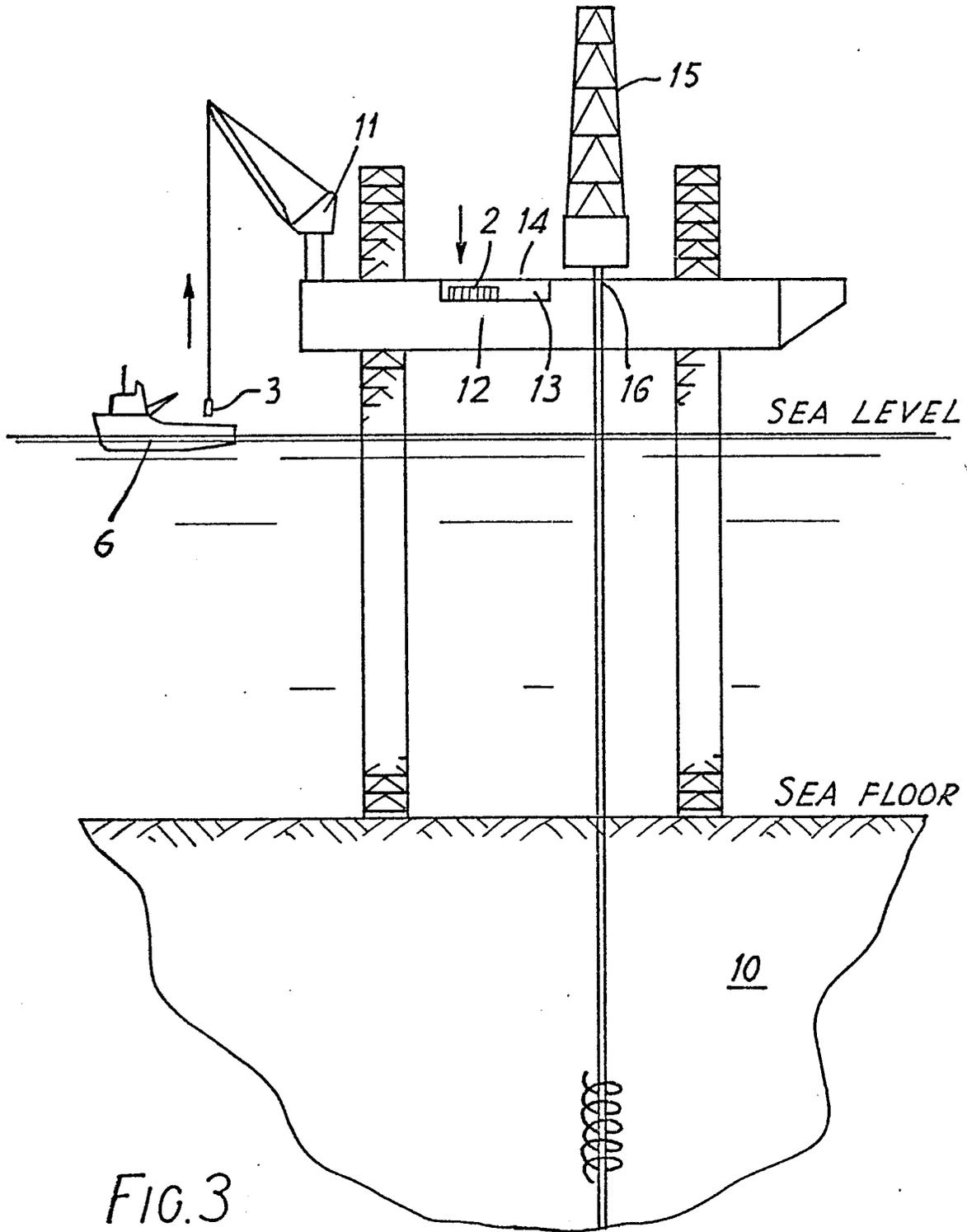
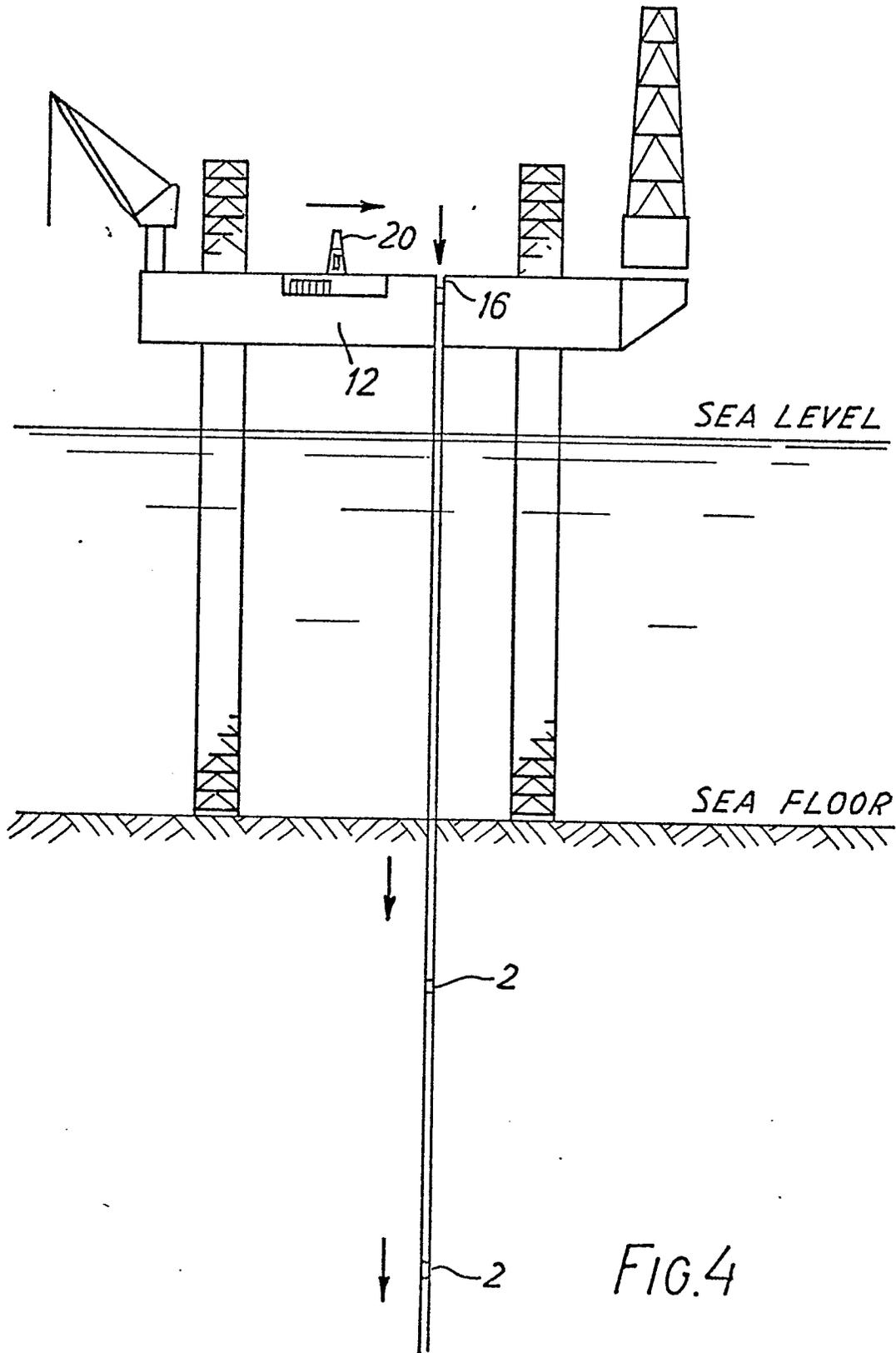


FIG. 2

FIG. 1





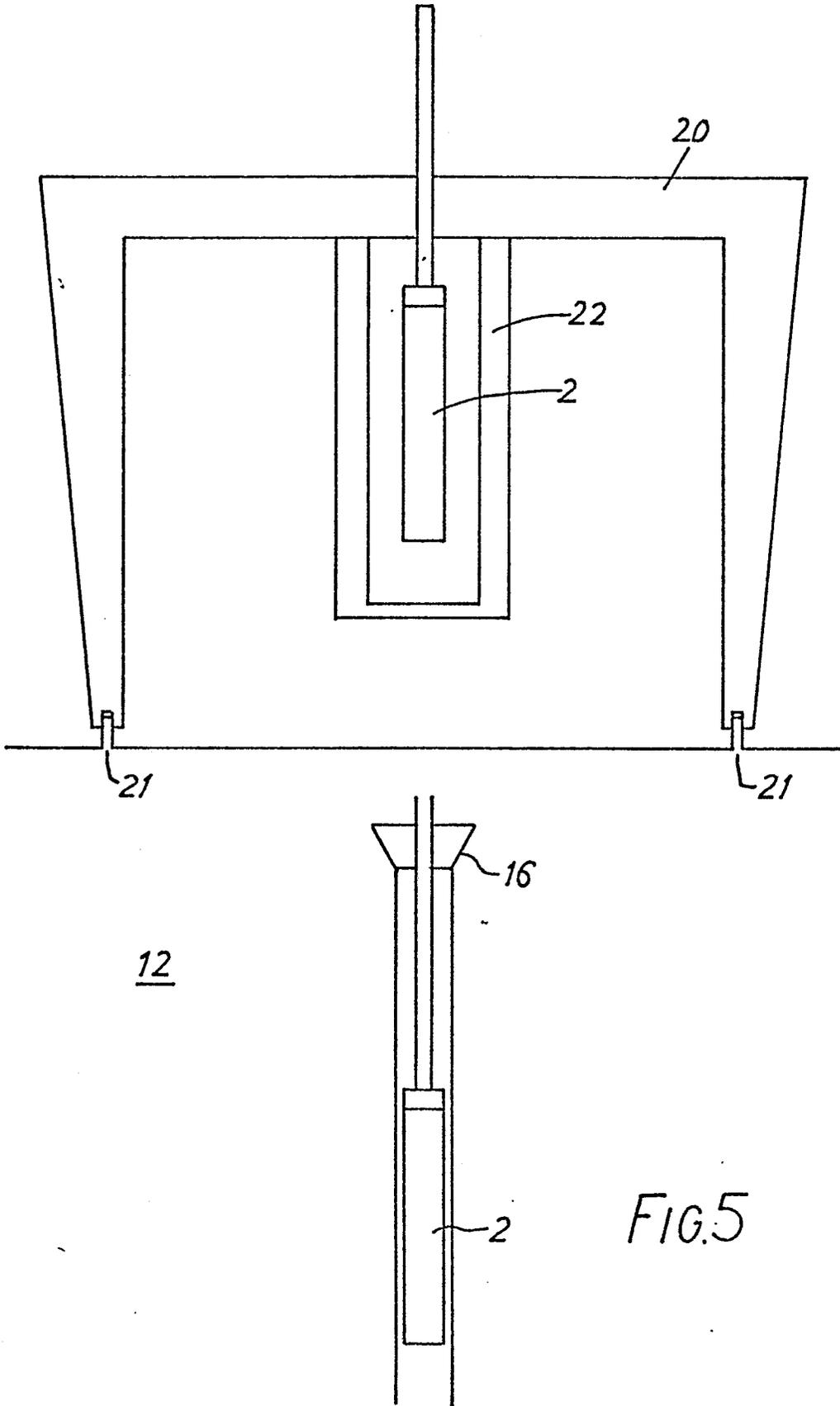


FIG.5

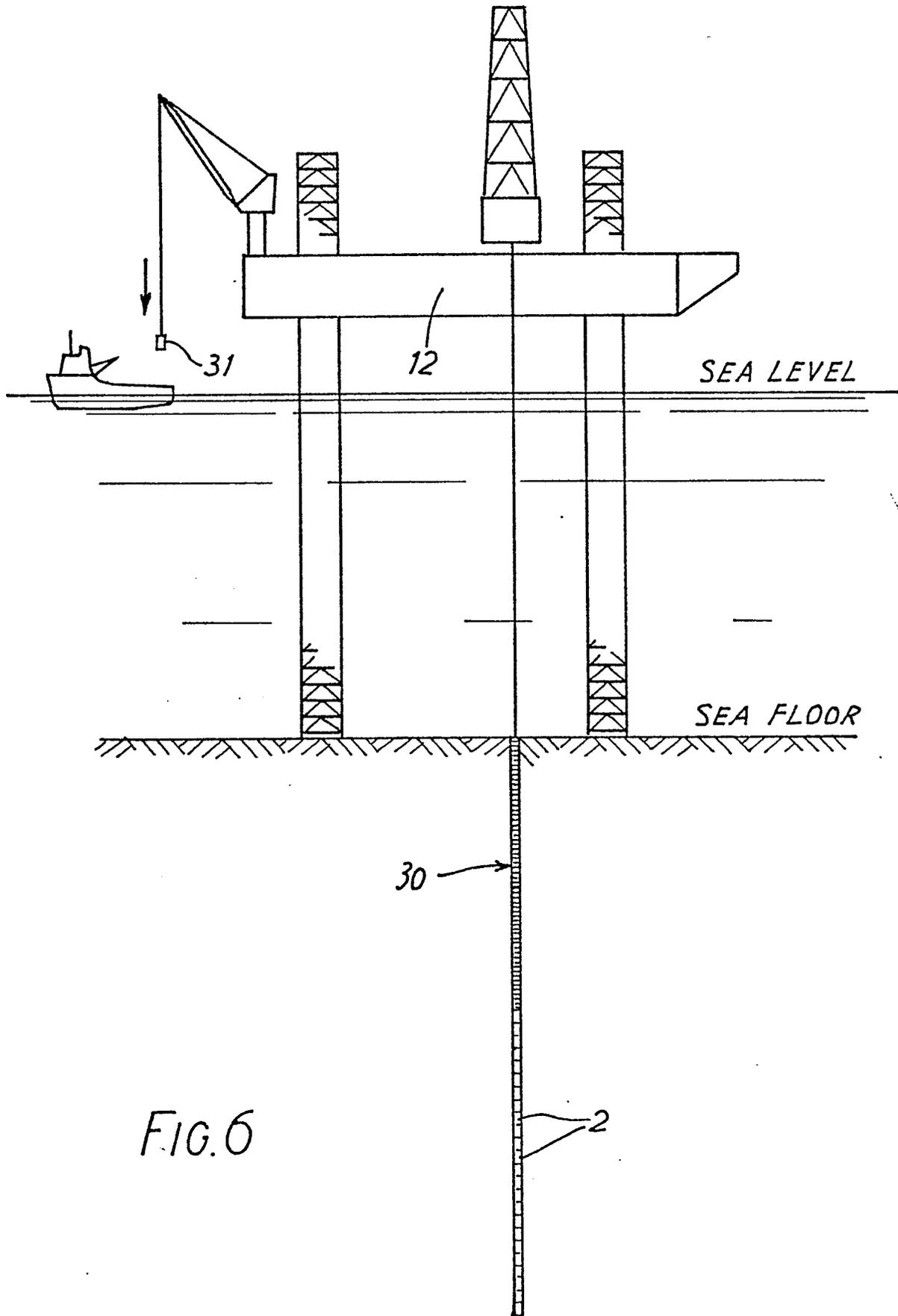


FIG. 6

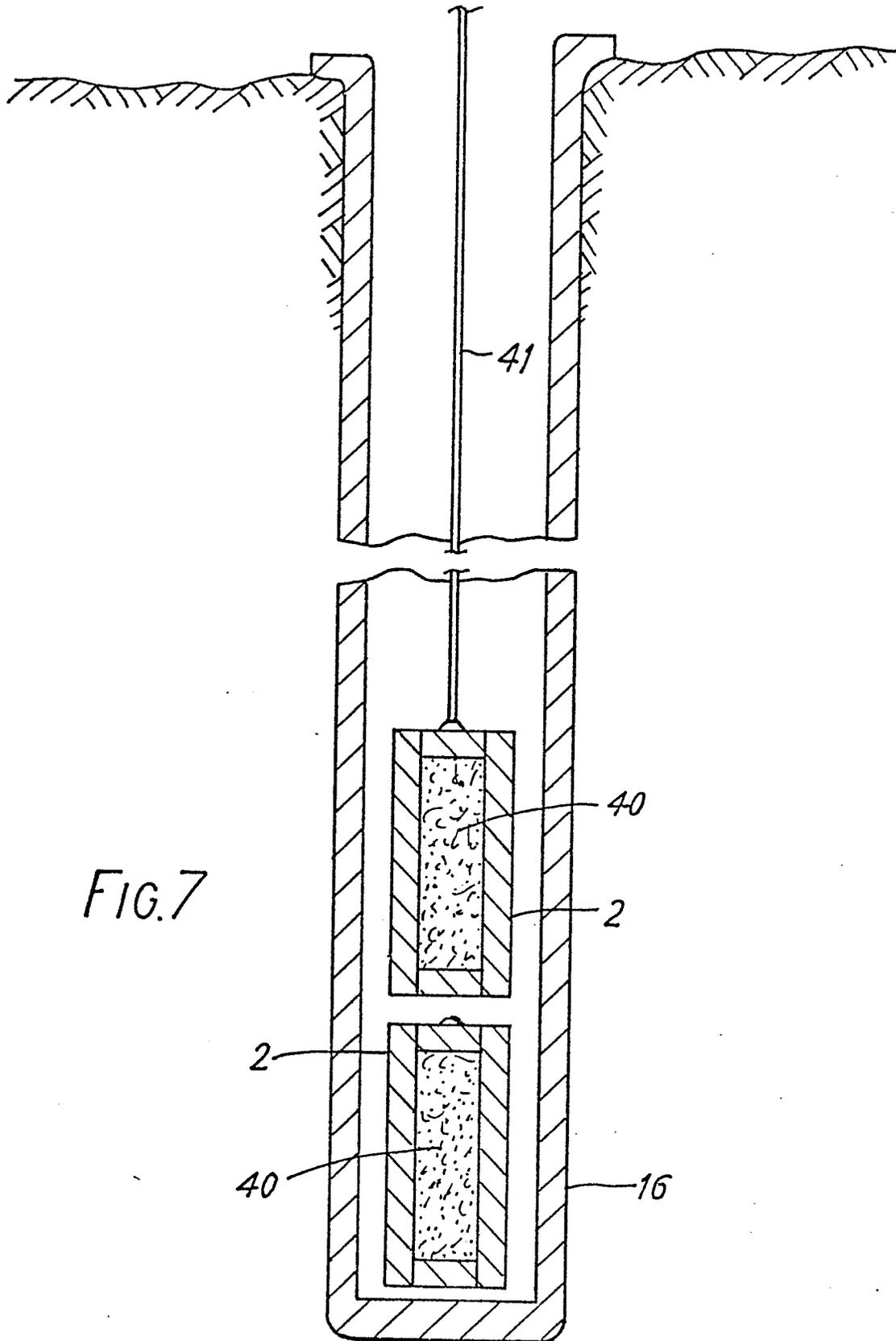


FIG. 7

