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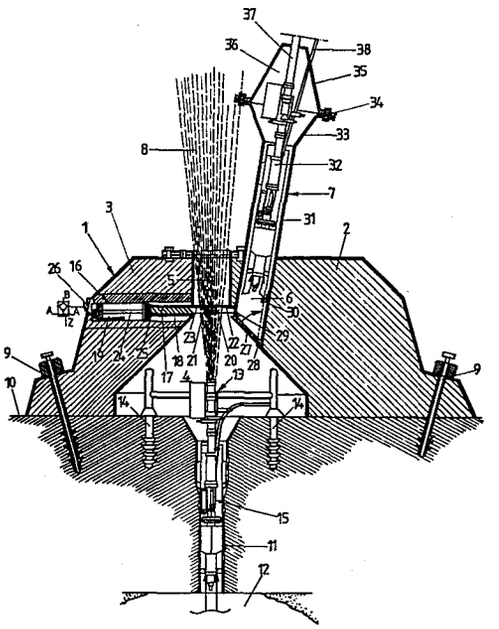
(54) Apparatus for confining and controlling a flow of fluid from an oil/gas source, especially in an uncontrolled blow-out on the sea bed.

(57) An apparatus for confining and controlling a flow of fluid from an oil/gas source, especially is an uncontrolled blow-out from a location on the sea bed. The apparatus comprises a confinement member (1) arranged to be placed on and attached to the sea bed or the like over the blow-out location, and which comprises at least two sections (2, 3) arranged to be moved laterally together and locked to each other in a position in which the sections together define a central, downwards open cavity (4) passing into a first upwards directed flow passage (5), one of the sections alone defining a second upwards directed flow passage (6) communicating with the cavity. The passages (5, 6) are provided with respective closing means (17 resp. 27) arranged to be operated in such a manner that the first passage (5) is closed during simultaneous opening of the second passage (6), the second passage (6) being connected to conduits (7) for carrying off the flow of fluid. The two sections (2, 3) are preferably connected to each other by a hinge means having an axis which extends essentially parallel to the first flow passage (5).



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Apparatus for confining and controlling a flow of fluid from an oil/gas source, especially in an uncontrolled blow-out on the sea bed

The present invention relates to an apparatus for confining and controlling a flow of fluid from an oil/gas source, especially in an uncontrolled blow-out from a location on the sea bed, comprising a confinement member arranged to be placed on and attached to the sea bed or the like above the blow-out location, and which is provided with means for transferring and conveying the flow of fluid to subsequent means for treatment of the fluid.

There are previously known several methods and apparatuses for use in connection with uncontrolled blow-outs from oil/gas sources on the sea bed, and which aim at achieving confinement and collection of and concequently control over the fluid gushing out from the source. As an example, reference can be made to Statoil Report No. STF. 88 A81004, "Offshore Blowout Control", of April 10, 1981. In said publication there are described different types of dome or hood structures, and a common feature thereof is that the hoods are tight and only provided with relief valves for gas and oil. In these solutions it is a big problem to place and install said hoods above the blow-out location on the sea bed, the fluid usually gushing out under a very high pressure.

An apparatus of the introductorily stated type is by way of example known from US patent specification No. 3 548 605. This patent specification shows a confining and guiding means which is intended to be lowered to the sea bed and to be attached by means of piles or the like, and which has an opening for through-

flow of oil and gas to a channel means leading to the surface of the sea. However, also this known apparatus will be difficult to install above a blow-out location, the apparatus having to be passed through and will be disturbed by the column of the fluid gushing out from the source under a high pressure.

The object of the invention is to provide an apparatus which is without the above-mentioned drawbacks of the prior art, the apparatus enabling safe and reliable placing and installation without being disturbed by the flow of fluid during the installation phase.

For the achievement of the above-mentioned object there is provided an apparatus of the introductorily stated type which, according to the invention, is characterized in that the confinement member comprises at least two sections arranged to be moved laterally together and locket to each other in a position in which the sections together define a central, downwards open cavity passing into a first upwards directed flow passage, one of the sections alone defining a second upwards directed flow passage communicating with the cavity, and that said passages are provided with respective closing means arranged to be operated in such a manner that the first passage is closed during simultaneous opening of the second passage, the second passage being connected to conduits for carrying off the flow of fluid.

As a result of the fact that the confinement member comprises at least two sections which can be moved laterally together as stated, one achieves the essential advantage that the apparatus can be placed and installed without comming in contact with or being prevented to any substantial degree by the discharging fluid, something which enables a safe and reliable installation.

According to an advantageous embodiment of the invention, the confinement member comprises two sections which are connected to each other by a hinge means having an axis which extends essentially parallel to the first flow passage, the sections having mutually adapted abutment surfaces which, by pivoting the sections about said axis, can be brought together for defining the flow passage, and the sections being provided with cooperating locking members engaging with each other when the sections are brought together. After the sections having been brought together and locked to each other in the desired position above a blow-out location, e. g. on the sea bed, the apparatus is attached to the ground. For this purpose the sections are advantageously provided along their lower peripheral edges with a number of holes for the reception of fastening bolt means having bolts which are arranged to be shot into the ground and to thereby provide barbs protruding from the bolt means for fastening in the ground. The flow of fluid flowing through the open first flow passage which is defined between the sections, thereafter can be directed to the second flow passage, the first passage being closed and the second passage simultaneously being opened for through-flow of the fluid to the connected conduit system.

The invention will be further described below in connection with exemplary embodiments with reference to the accompanying drawings, wherein

Fig. 1 shows a vertically sectioned view of a first embodiment of the apparatus according to the invention installed on a planar ground;

Fig. 2 shows a vertically sectioned view of a second embodiment of the apparatus according to the invention installed on an uneven ground;

Fig. 3 shows an embodiment of the apparatus according to the invention viewed from above in partly

opened condition;

Fig. 4 shows an apparatus according to the invention viewed from the underside in closed condition;

Fig. 5 shows a schematic view of the apparatus in Fig. 2, partly in perspective and partly in side view;

Fig. 6 shows a view corresponding to Fig. 5, but showing the apparatus viewed from the opposite side;

Fig. 7 shows a longitudinally sectioned view of a fastening bolt means for attachment of the apparatus according to the invention to a ground; and

Fig. 8 shows a side view (partly in section) of an apparatus according to the invention installed above a blow-out location on a sea bed and connected to a surface vessel through a conduit system.

In the drawings, the same reference numerals are used to designate the same or corresponding members in the different Figures.

The apparatus shown in Fig. 1 comprises a bell-shaped delimitation or confinement member 1 which is bipartite and composed of a first section 2 and a second section 3 and thus forms a bipartite relief valve. The sections 2, 3 are arranged to be moved laterally together and locked to each other in the shown position in which the sections together define a central, downwards open cavity 4 passing into a first upwards directed flow passage 5. The cavity is executed with smooth inner walls and without protruding portions or sharp edges, i. a. to avoid charging and discharging of static electricity. Advantageously, the sections may be hinged together as shown e. g. in Figs. 3 and 4. In the first section 2 there is provided an additional or second upwards directed flow passage 6 which, at its lower end, communicates with the cavity 4 and at its upper end is connected to a conduit system 7 for carrying off the flow of fluid 8 which is to be confined and guided by means of the apparatus. As shown, the sections 2, 3 are made of massive blocks of a suitable material, for

instance steel. Recesses or cavities (not shown) may be provided in the blocks, with a view to material saving and weight reduction. Each of the sections 2, 3 are provided along their lower peripheral edge with a number of holes for the reception of fastening bolt means 9 for attachment of the apparatus to the ground, as further described in connection with Fig. 7.

In Fig. 1 the apparatus is shown to be installed on a planar ground 10 which may be a sea bed or possibly a deck of an oil platform or the like. In the Figure it is the question of a sea bed in which a borehole 11 has been drilled down to an oil deposit 12. On the sea bed 10 there is placed a well head 13 which is attached to the sea bed by fastening means 14 and is connected to a Christmas tree 15 protruding a distance downwards into the borehole 11. The well head with associated Christmas tree is of commonly known type and will not be further described as it does not constitute a part of the present invention.

The first flow passage 5 is arranged to be closed by means of a closing means 16 comprising a first gate 17 which is arranged in the second section 3 and is connected to an externally actuable driving means for movement of the gate between positions in which the passage 5 is closed and open, respectively. Advantageously, the gate is made of an acid-resisting steel having a great hardness. In the illustrated embodiment the gate 17 is in the form of a sliding gate which is displaceably arranged in a suitable guide 18 in the section 3 and is connected to a hydraulic/pneumatic drive cylinder 19 mounted in a suitable cavity in the section 3. The sliding gate 17 may have a circular peripheral shape, or the peripheral shape may be essentially rectangular or rounded. Respective grooves 20 and 21 are provided in the sections 2 and 3 at the lower end of the flow passage 5, for receiving the sliding gate 17 in closed position.

Along their upper side these grooves are provided with suitable sealing gaskets 22 and 23, respectively, for sealing abutment against the upper side of the peripheral portion of the sliding gate 17 when the gate has been brought to the closing position.

The hydraulic/pneumatic drive cylinder 19 is of a suitable known type and has a piston rod 24 which is connected to the sliding gate 17. Between the sliding gate and the drive cylinder there is further shown to be arranged a corrugated, compressed rubber sleeve 25 which is extended when the sliding gate is brought to the closing position (see Fig. 2). As schematically suggested in Fig. 1, the drive cylinder is connected to a manometer and control unit 26 for possibly remotely controlled or data controlled operation of the drive cylinder, e. g. from the sea surface when the apparatus as illustrated is installed on the sea bed. The cylinder is normally closed and is under pressure during use. By way of example, a symbol for a possible control is shown in connection with the control unit 26.

The second flow passage 6 is provided with a closing means which is shown in the form of a gate 27 which, in closed position, covers the lower opening of the passage 6 and is tilted with an inclination corresponding to the wall of the cavity 4. At its lower side edge the gate 27 is mounted about a horizontal shaft 28 and is kept in closed position by means of a resilient fastening means 29 yielding at a certain pressure. Thus, when the pressure in the cavity 4 exceeds a certain limit, the gate 27 is automatically opened and urged inwards towards the wall of the passage to a position (shown dotted in Fig. 1) wherein the gate is locked by a locking means 30 attached to the wall. Thus, when closing the sliding gate 17, the gate 27 is automatically opened, as described below in connection with the operation of the apparatus.

The conduit system 7 which is connected to the second flow passage 6, in Fig. 1 is shown to comprise a tube 31 having a relatively large diameter (e. g. ca. 75 cm) and wherein there is placed a Christmas tree arrangement 32 having as its task to separate oil and gas in the flow of fluid 8 when this is diverted from the flow passage 5 and flows upwards through the flow passage 6. In the illustrated embodiment the tube 31 has a conically fladred portion 33 at its upper end, to which portion a conically tapering cover 35 is fastened by way of a flange joint 34. Thus, the portion 33 and the cover 35 define an enlarged cavity 36 for receiving the more bulky upper part of the shown Christmas tree equipment. Advantageously, the used Christmas tree equipment is the same as that which is used in the borehole 11, i. a. with a view to correct adaptation to the ratio between oil and gas in the fluid flowing up from the source in question. Normally, said ratio will have been ascertained in connection with drilling and testing of the borehole in question.

The tube members 31, 33, 35 and the Christmas tree equipment 32 placed therein are permanently mounted to the first section 2 which is the larger one of the two sections in the bipartite relief valve according to the invention. Instead of the shown arrangement with the enlargement 33, 35, a straight tube 31 can of course be used when permitted by the size of the Christmas tree arrangement. As regards Christmas tree and valve equipment, also a number of alternative arrangements can be contemplated. By was of example, there may be provided a straight tube (corresponding to the tube 31) with an internal tube arrangement to which there are connected suitable valves intended for control and throttling of oil and gas and protruding outside the straight tube.

As shown in Fig. 1, a tube 37 for transport of oil and a tube 38 for transport of gas are connected to the Christmas tree equipment 32 and are passed through the upper cover 35. The tubes 37, 38 extend up to the sea surface as

more closely shown in Fig. 8, and the oil tube may be connected to a system for collection of the oil, whereas the gas tube may be arranged for burning of discharging gas. On the top of the relief valve in Fig. 1 there is also suggested, with dotted lines, a top cover which is presupposed to be mounted over the flow passage 5 after the flow of fluid 8 has been diverted to the second flow passage 6. The top cover arrangement will be further described in connection with Fig. 2.

In Fig. 2 there is shown a modified embodiment of the apparatus according to the invention wherein the apparatus is shown to be installed on an uneven sea bed 50. The embodiment essentially corresponds to the embodiment in Fig. 1, and corresponding members are designated by the same reference numerals as in Fig. 1 and will not be described again. As distinct from the embodiment in Fig. 1, the sections 2, 3 are not manufactured from solid material, but each section is made of sheet material, e. g. steel plates, forming outside and inside walls or shells and defining an internal cavity 51 and 52, respectively. This embodiment is especially intended to be located on an uneven ground. As shown, the shell walls have depending skirt portions in the form of inner skirts 53 and outer skirts 54 which, in connection with securing of the relief valve, are pressed into the sea bed 50 by means of the bolt means 9, so that a tight bell system is formed. In this manner excavation in the bottom under the bell-shaped relief valve is avoided.

For the fixing bolts 9 in this embodiment there are provided steel sleeves 55 having conical holes for mounting of bolts with barbs (see Fig. 7).

The internal cavities 51, 52 are intended to be filled with concrete after the relief valve has been installed on the sea bed. For this purpose there are provided filling valves 56 arranged to be connected to respective hoses 57 for supply of concrete 58 from the surface. Further, on the top of the sections there are

provided water separation ports 59. When supplying concrete through the hoses 57, the concrete will gradually fill the internal cavities 51 and 52 and form a seal against the sea bed, and the relief valve will be filled with a compact mass. Water and possibly mud will be pressed out from the water separation ports 59 which are located at a higher level than the filling valves 56, and when the cavities are filled this will be indicated in the ports 59. The utilized concrete will be a quick-setting special concrete.

In the embodiment in Fig. 2, the flow passage 5 is closed by the sliding gate 17, so that the fluid (oil and/or gas) discharging from the borehole 11 will flow through the flow passage 6 to the tube system 7. The will head 13 shown in Fig. 1 and the Christmas tree 15 in the borehole 11 may be collapsed or may not be installed.

The flow passage 5 is shown to be closed by a top cover 60. This is pivotally mounted by means of a guide pin 61 and is provided along its periphery with a plurality of holes 62 (see Fig. 3) for fixing bolts 63 for fixing in corresponding holes in each of the sections. During placing and assembly of the sections 2, 3, the cover 60 is turned aside so that the flow passage 5 is not covered. After the sections 2, 3 having been installed and the flow of fluid having been diverted to the second flow passage, so that the blow-out in question is under control, the top cover 60 is moved in place over the flow passage 5 and is secured by means of the bolts 63, so that the sections are bolted together to a unit. The guide pin 61 comprises a suitable bearing (not shown) for turning of the top cover, and there are also provided for additional guides so that the top cover is brought to the correct position in a safe manner. All parts, such as guide pin, bearing, fastening bolts, advantageously are made of an acid-resisting steel.

In some cases it may be expedient to fill the flow passage above the gate 17 with concrete or the like, as

an additional precautionary measure. For this purpose the top cover 60 may be provided with suitable valves (not shown) for bringing down concrete.

On the top cover 60 there is further shown to be provided a security valve 64 which may be applied in connection with throttling of the flow of fluid after a blow-out has been brought under control. The security valve 64 is of standard type and includes the usually components and instruments. Thus, in the Figure there is suggested a manual main valve 65, a hydraulic main valve 66, a flap valve 67, a top valve 68 and a manometer 69. The manometer is used to check that the valve is tight.

In fig. 3 there is shown a preferred embodiment of the apparatus according to the invention wherein the two sections 2, 3 are hinged to each other by a hinge means 80 and are arranged to be locket to each other in closed position by a locking means consisting of a hook 81 and a stop 82. The embodiment is shown in plan view and corresponds to the embodiment in Fig. 1. In Fig. 3 the apparatus is shown in somewhat opened position wherein it has approximately horseshoe or caliper shape, and by means of the hinge means it may be further opened to an opening angle of ca. 160^{o}.

The hinge means 80 is in the form of a bearing having an axis extending essentially perpendicularly to the bottom surfaces of the sections 2, 3 and also essentially parallel to the first flow passage 5 defined by the sections in their closed position. Each of the sections 2, 3 is provided with a bearing holder 83 and 84, respectively, which is connected to a respective bearing member consisting of a bearing bushing 85 and a thrust bearing 86. The bearing members are rotatable about a bearing bolt 87 (shown in section) which may have an upper top flange (not shown).

The stop 82 of the bearing means consists of a pin which is displaceably mounted in a suitable recess 88 in the section 2. The inner end of the pin 82 is pro-

vided with a flange 89, and between this flange and the bottom of the recess 88 there is placed a spring 90 urging the pin 82 from an inner position to an outer blocking position for engagement behind an end projection 91 on the hook 81 when the sections 2, 3 are brought together to closed position (see Fig. 4). The pin 82 may be released for outgoing movement in that a suitable blocking means (not shown) is released when the hook 81 passes the pin 82.

As appears from Fig. 3, the sections have mutually adapted abutment surfaces 92, 93 having respective, part-cylindrical recesses in the central area for defining the first flow passage 5 in Fig. 1. Along the top and side portions of the abutment surface 93 of the second section 3 there is provided a sealing flange or rib 94, and the abutment surface 92 of the first section 2 is provided with a corresponding groove 95 for receiving the flange 94 when the sections are in their closed position. The flange 94 may be made of a suitable plastic material, for example polyethylene which has a low friction, is wear-resistant, endures rough treatment (blows) and yields a good tightening.

On their upper side along said abutment surfaces each of the sections 2, 3 is provided with a number of illumination means 96 for providing the necessary illumination during the installation phase on the sea bed, and also with a number of television cameras 97 for monitoring the installation operations. The illumination means as well as the TV cameras may be provided with infrared lenses for improving the visibility. The placing and installation of the relief valve over a blow-out location on the sea bed may all the time be monitored and controlled from the surface by means of television communication and a suitable system for transmitting control and operating signals to the apparatus.

In lowering of the relief valve to the sea bed, suitable sea-borne cranes are used, each of the sections being suspended from hooks on crane wires by means of suitable hook mounts 98. In Fig. 3, three such mounts are provided on each section, so that the position of the sections may be adjusted as required. In this connection it should be mentioned that ballast means may also be used in connection with the lowering operation.

In Fig. 3 there are also shown the above-mentioned holes 62 for mounting of the top cover 60 of the relief valve (see Fig. 2). However, for the sake of clarity, the top cover itself is omitted. Further, the Figure shows a plurality of holes 99 arranged along the lower peripheral edge of each section, for receiving the fastening bolt means 9.

Fig. 4 shows a schematic view of an embodiment according to the invention viewed from the underside. The embodiment essentially corresponds to the embodiment of Fig. 3, except that the hinge means 80 and the locking means 81, 82 have changed places. The Figure illustrates how the central cavity tapers upwards towards the flow passages 5 and 6.

Figs. 5 and 6 show schematic views of opposite sides of the embodiment according to Fig. 2, shown partly in perspective and partly in side view. In Fig. 5, the relief valve has an orientation corresponding to that of Fig. 2, and the Figure shows the bearing means 80 arranged on the outer peripheral edge below a lower step 100 of the relief valve with the sleeves 55 for the fastening bolts 9, in a similar manner as in Fig. 3. As an alternative, there is shown a bearing means 80' which is arranged on the portion of the relief valve located above the lower step 100, which portion is shown to be wider than the lower peripheral edge and thus provides a stronger bearing arrangement. Instead of the illustrated alternatives, one could also build up the base for the bearing means

so that said means could have a height corresponding to e. g. the sum of the heights of the bearing means 80 and 80'.

It appears from Fig. 6 that, along the outer edge portions of the adjacent abutment surfaces of the sections, there are provided respective lengths of angle irons 101 and 102, respectively, which, after the sections 2, 3 are brought together to closed position, are pressed together by means of a suitable means of bolts with associated nuts, to thereby squeeze the sections together. Corresponding angle irons and bolt sets may also be provided on the opposite side of the relief valve.

The turning of the hinged sections 2, 3 from open to closed position can, by way of example, be carried out by means of hydraulic devices. For this purpose hydraulic cylinders may e. g. be provided in connection with the bearing means 80. However, this arrangement is not shown in the drawings.

Fig. 7 shows on an enlarged scale a longitudinally sectioned view of a fastening bolt means 9. The means comprises a conical bolt sleeve 110 having a plurality of barbs 111, an upper flange 112 and a sealing point 113, and further a correspondingly conic steel bolt 114 having a head 115 on the upper surface of which there is placed a ridge 116 of soft metal. As previously mentioned, inclined holes 99 for receiving the conical sleeves 110 of the bolt means 9 are provided in the lower peripheral portion of the corresponding section 2 or 3. As shown, a ring flange 117 of acid-resisting, soft steel is fastened by welding over each hole 99. The barbs 111 of the sleeve 110, which barbs are of cylindrical shape, in the initial condition are located within the sleeve, the barbs being located in downwards inclined holes (angle of inclination ca. 60^{o}) and are fixed by point welding on the outer side of the sleeve.

When the relief valve according to the invention has been installed in the correct position on the sea bed

10, a conical sleeve 110 is placed in one of the holes 99. The sleeve is shot into the sea bed by means of a suitable driving device and a explosive charge having a charge of accurately calculated size. As a result of high impact velocity (ca. 8200 - 8400 m/s) no noticeable recoil occurs. After the sleeve 110 has been shot in place, a bolt 114 is placed in the sleeve so that it engages the uppermost barb in the sleeve. The bolt is thereafter shot into the sleeve in a manner corresponding to that of the sleeve, and the barbs 111 are thereby driven outwards through the sleeve wall and fasten themselves in the base or ground. Because of the pressure and the water which is present in the sleeve, the sleeve point 113 will be driven out from the sleeve when the bolt is shot in place. The bolt will be driven so far that it sticks well in the sleeve. After the fastening bolt means has been shot in place in the described manner, the same fastening operation is carried out with the remaining fastening bolt means. By means of this structure a very effective and time-saving attachment of the relief valve is obtained.

Fig. 8 shows a partly sectioned side view of an apparatus 1 according to the invention which is installed over a blow-out location 120 at the sea bed 10 and is connected to a surface vessel 121 through a conduit system. In the Figure, discharging oil and gas from the blow-out location has been diverted to the second flow passage 6, the first flow passage 5 being closed by the gate 17. The conduit system comprises the tube 7 with associated Christmas tree and the oil transporting tube 37 which, by means of a number of tube sections 122 with flange joints 123, is extended up to the sea surface 124 where the uppermost tube section is connected to a flexible hose 125 which is kept afloat by means of buoyancy bodies 126 and is brought on board the vessel 121 to a suitable collecting means.

In order to avoid formation of verdigris in the tube extending from the relief valve to the sea surface 124, a combination of nylon and steel outside each other may be used. The tube may then be made flexible, something which results in less strain on Christmas tree and tube system.

The gas-transporting tube 38 is also, by means of a plurality of tube sections 127 and flange joints 128, carried up to the sea surface 124 and extends a distance above the sea surface to an outlet 129 where the discharging gas 130 is burnt. The gas tube sections 127 are connected to the oil tube sections 122 by means of reinforcing bracings 131.

A summarizing description of the various operational steps in the installation and operation of the described relief valve according to the invention will be given in the following.

When an uncontrolled blow-out at the sea bed has occurred and the relief valve according to the invention has been transported to the site of the accident, the valve apparatus is lowered to the blow-out location by means of a crane vessel, the lowering operation being monitored from the crane vessel or an operating vessel by means of TV communication, there being provided for transmission connections between the vessel and the TV cameras 97 (Fig. 3) mounted on the relief valve. The sections 2, 3 of the relief valve are lowered in open position and moved inwards towards the blow-out location from the side right down at the sea bed. Thereby the pressure from the discharging fluid column is avoided and the valve is moved inwards towards the blow-out column where it is concentrated, i. e. before it begins spreading out and forming the so-called "plume". When the valve apparatus has been brought in position at the blow-out location, the valve is closed (hydraulically), care be taken, by means of the illumination means and the TV cameras,

that the center of the blow-out is located centrally in the first flow passage of the valve when final closing of the valve apparatus is carried out. The illumination units and the TV cameras have to be mounted in a particular pattern, so that the operators on the operating vessel all the time can have a survey of the relative position of the sections and their position in relation to the blow-out column. For example, there may be provided for a pair of light beams crossing each other at a suitable, chosen angle, the arrangement being such that a flashing light signal in the center of the operator's data screen is obtained when the valve is in the correct position at the time of closing.

When the valve apparatus 1 is closed and the sections 2, 3 are locked to each other by means of the locking means 81, 82, the apparatus is lowered until it rests on the sea bed, whereafter it is anchored to the sea bed by means of the fixing bolt means 9, as described in connection with Fig. 7. This work is carried out by means of divers.

When the relief valve 1 is fixed to the sea bed and it has been checked that all details are correctly placed, the drive cylinder 19 for the sliding gate 17 is activated by manual or remotely controlled operation, so that the sliding gate 17 closes the flow passage 5. Simultaneously, the gate 27 for the flow passage 6 is automatically opened, in the illustrated embodiment as a result of the pressure increase in the central cavity 4. Thus, the flow of fluid is diverted to the tube system 7 with the associated Christmas tree or valve arrangement. Thereafter, the top cover 60 with safety valves is brought in place over the flow passage 5. Advantageously, the top cover can be pivoted or pulled in place by means of a hydraulic cylinder (not shown), or alternatively by means of a winch controlled from the surface, there being camera coverage of the whole operation. When the top cover is brought in place and the oil pressure gauge has been checked, the

fastening bolts of the cover are inserted and tightened by means of an automatic nut tightener.

While the work with the top cover is in progress, the Christmas tree and gas separator in the tube system 7 are in quite open position and oil and gas flow freely in the tube system up to the sea surface where the gas may be ignited and the oil spray may be rather high. The oil and gas tubes should therefore have a good distance from each other at the surface. It is presupposed that oil dams and collecting equipment are brought into position to take care of the oil.

The throttling may start only when the top cover is put in place and secured. The throttling must take place gradually and may take some time, but the blow-out is now under control. The reduction of the pressure takes place from the surface where the oil pressure gauge in the Christmas tree is monitored all the time, the TV cameras being used to monitor the sea bed. When the throttling is completed, the transfer hose 126 laid out on the surface is connected to the oil tube, so that the oil can be transferred to the oil-collecting vessel 121 or the like.

The invention has been described above in connection with a preferred embodiment for use under water, and especially on the sea bed. The relief valve has been shown to comprise two sections which are hinged to each other. However, it may also be conceived to comprise more than two sections, and the sections do not necessarily have to be hinged to each other. By way of example, the valve may comprise two sections which are interconnected by means of rails, at least one of the sections being slidable on the rails so that the sections can be brought together in this manner.

The relief valve may also be adapted for use in submerged places other than on the sea bed, and also for use on drilling or production platforms, offshore as well as onshore. For such applications the relief valve may i. a. be made smaller and lighter of weight. The relief

valve may also be used in connection with test drilling, as an additional security. Installation of the valve apparatus then takes place before the test drilling is started. However, it will then be necessary to arrange a "tunnel" through one of the sections, in order to be able to get into the central cavity.

Patent Claims

1. Apparatus for confining and controlling a flow of fluid from an oil/gas source, especially in an uncontrolled blow-out from a location on the sea bed, comprising a confinement member arranged to be placed on and attached to the sea bed or the like over the blow-out location, and which is provided with means for transferring and conveying the flow of fluid to subsequent means for treatment of the fluid, characterized in that the confinement member (1) comprises at least two sections (2, 3) arranged to be moved laterally together and locked to each other in a position in which the sections together define a central, downwards open cavity (4) passing into a first upwards directed flow passage (5), one of the sections alone defining a second upwards directed flow passage (6) communicating with the cavity (4), and that said passages (5, 6) are provided with respective closing means (17 resp. 27) arranged to be operated in such a manner that the first passage (5) is closed during simultaneous opening of the second passage (6), the second passage (6) being connected to conduits (7) for carrying off the flow of fluid.

2. Apparatus according to claim 1, characterized in that the confinement member (1) comprises two sections (2, 3) which are connected to each other by a hinge means (80) having an axis which textends essentially parallel to the first flow passage (5), the sections (2, 3) having mutually adapted abutment surfaces (92, 93) which, by pivoting the sections about said axis, can be brought together for defining the first flow passage (5), and the sections (2, 3) being provided with cooperating locking members (81, 92) engaging with each other when the sections are brought together.

3. Apparatus according to claim 1 or 2, characterized in that the closing means of the first passage (5) comprises a first gate (17) which is displaceably mounted

in one of the sections (2, 3) and is connected with an externally actuable driving means (19) for movement of the gate (17) between positions in which the passage (5) is open and closed, respectively.

4. Apparatus according to claim 3, characterized in that the closing means of the second passage (6) consists of a rotatably mounted, second gate (27) which is maintained in closed position by a fastening means (29) yielding at a certain pressure, and is arranged to be rotated to open position when the fluid pressure in the inner cavity (4) exceeds a certain value.

5. Apparatus according to anyone of the claims 1 - 4, characterized in that the upper opening of the first passage (5) is arranged to be closed by a top cover (60) which is pivotally mounted on one of the sections (2, 3) and is provided with holes with through-going fastening bolts (63) for fixing in associated holes (62) in the individual sections.

6. Apparatus according to anyone of the claims 1 - 5, characterized in that the upper opening of the second passage (6) is connected with a tube (31) wherein there is placed a Christmas tree means (32) for separation of oil and gas, the tube (31) at its upper end being arranged to be connected with conduits (37, 38) for carrying off separated oil and gas, respectively.

7. Apparatus according to anyone of the claims 1 - 6, characterized in that the sections (2, 3) along their lower peripheral edges are provided with a plurality of holes (99) for receiving fastening bolt means (9) having bolts (114) which are arranged to be shot into the ground and to thereby provide barbs (111) protruding from the bolt means (9) for attachment in the ground.

8. Apparatus according to anyone of the preceding claims, characterized in that illumination means (96) for illumination of the sections during assembly are mounted on at least one of the sections (2, 3), and that

a number of TV cameras (97) for monitoring the assembly from a remote location are also mounted on the sections.

9. Apparatus according to anyone of the preceding claims, characterized in that each of the sections (2, 3) is formed from sheet material forming outside and inside walls and defining an internal cavity (51 resp. 52), and that the sections are provided with openings (56) for connection to respective supply means (57) for injecting a filling material (58), such as concrete, in said cavities.

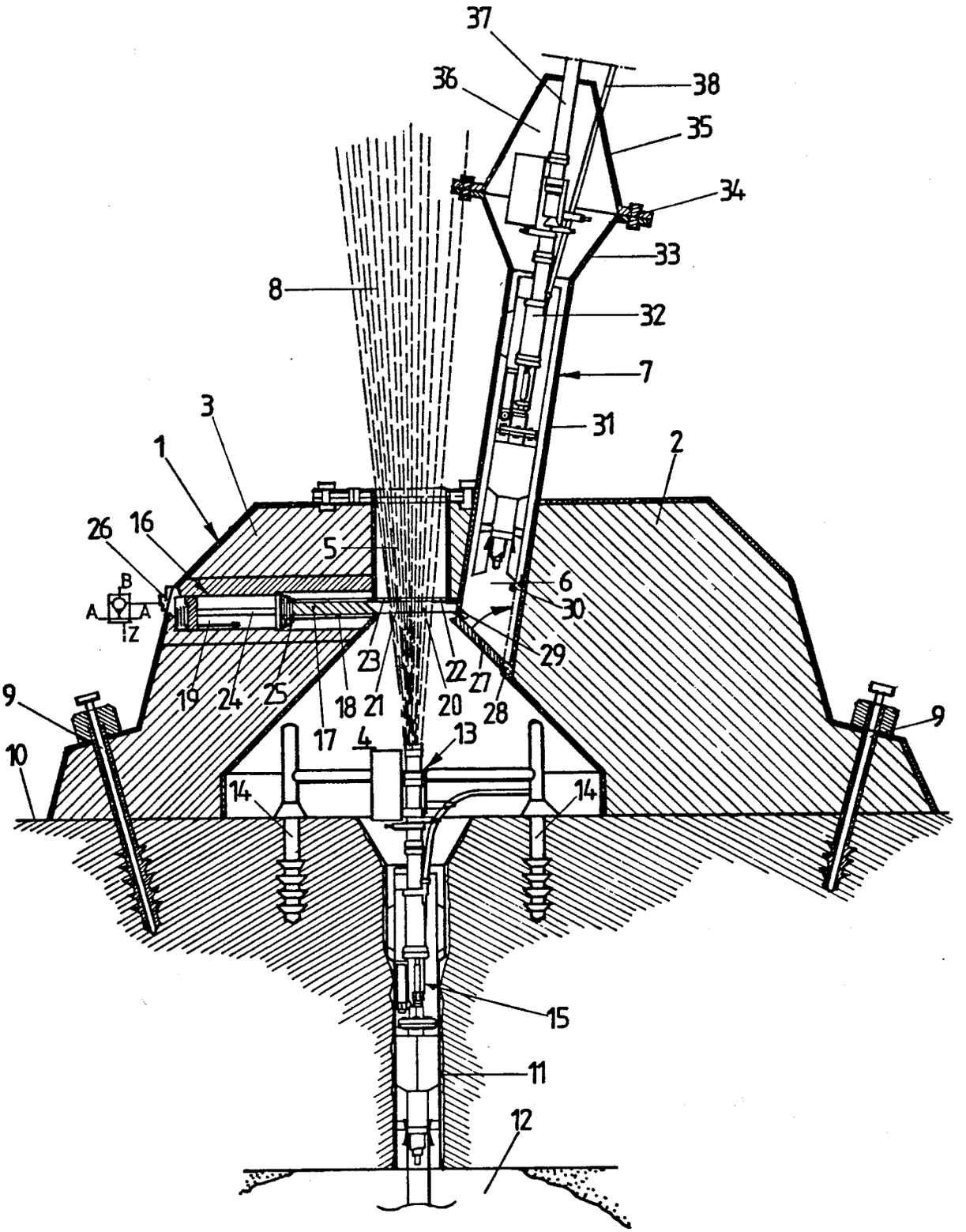
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FIG.1

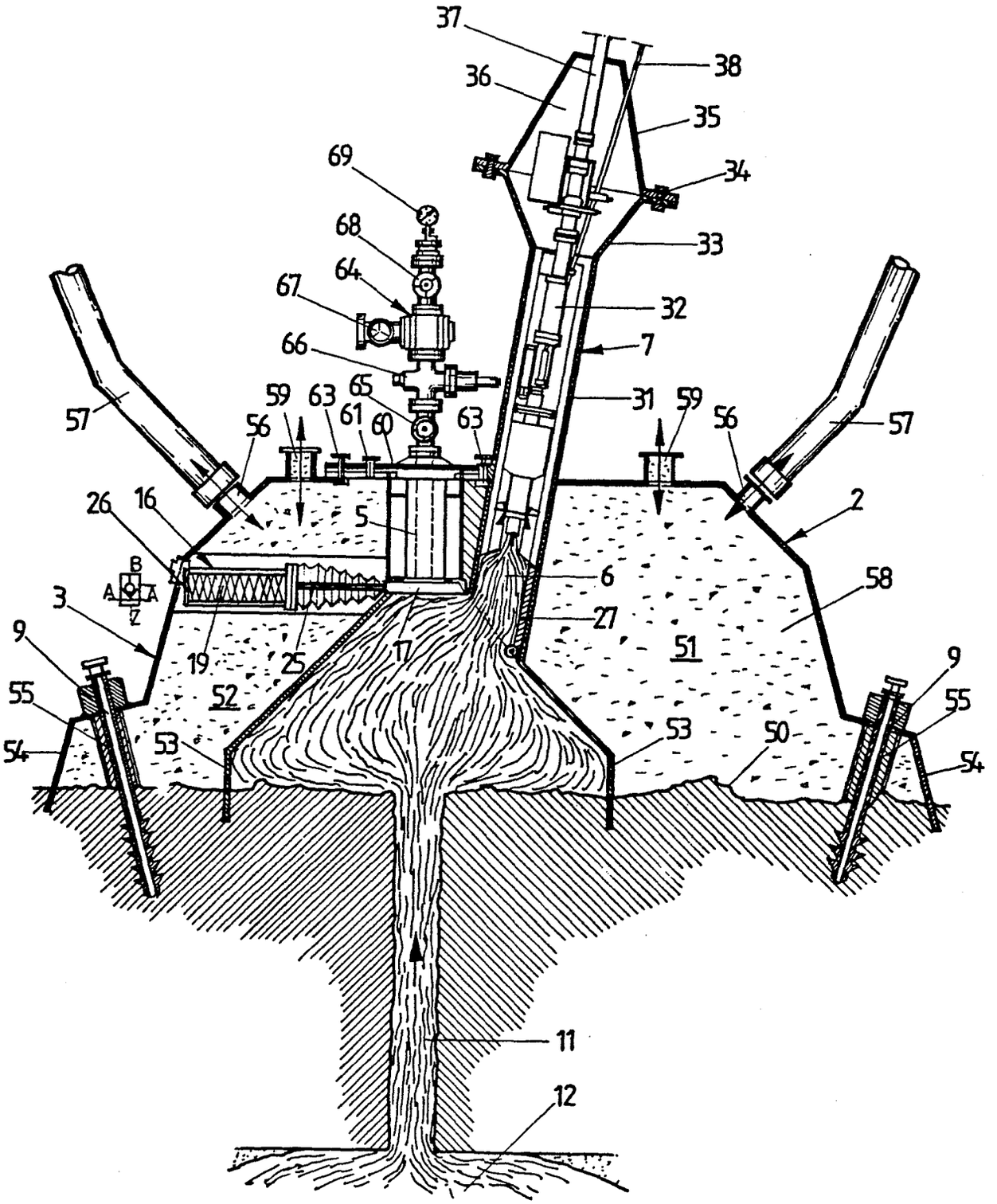
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FIG. 2

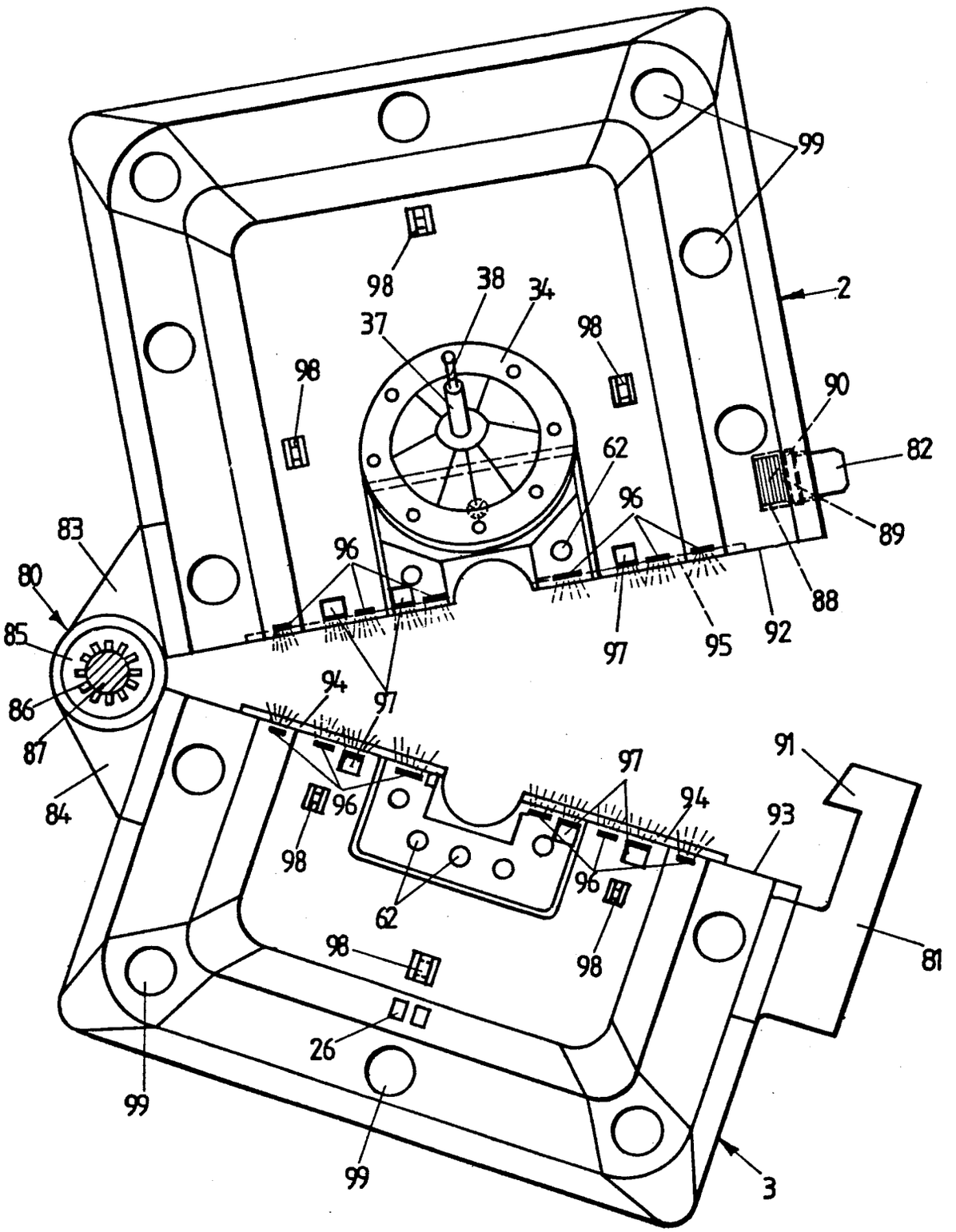
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FIG. 3

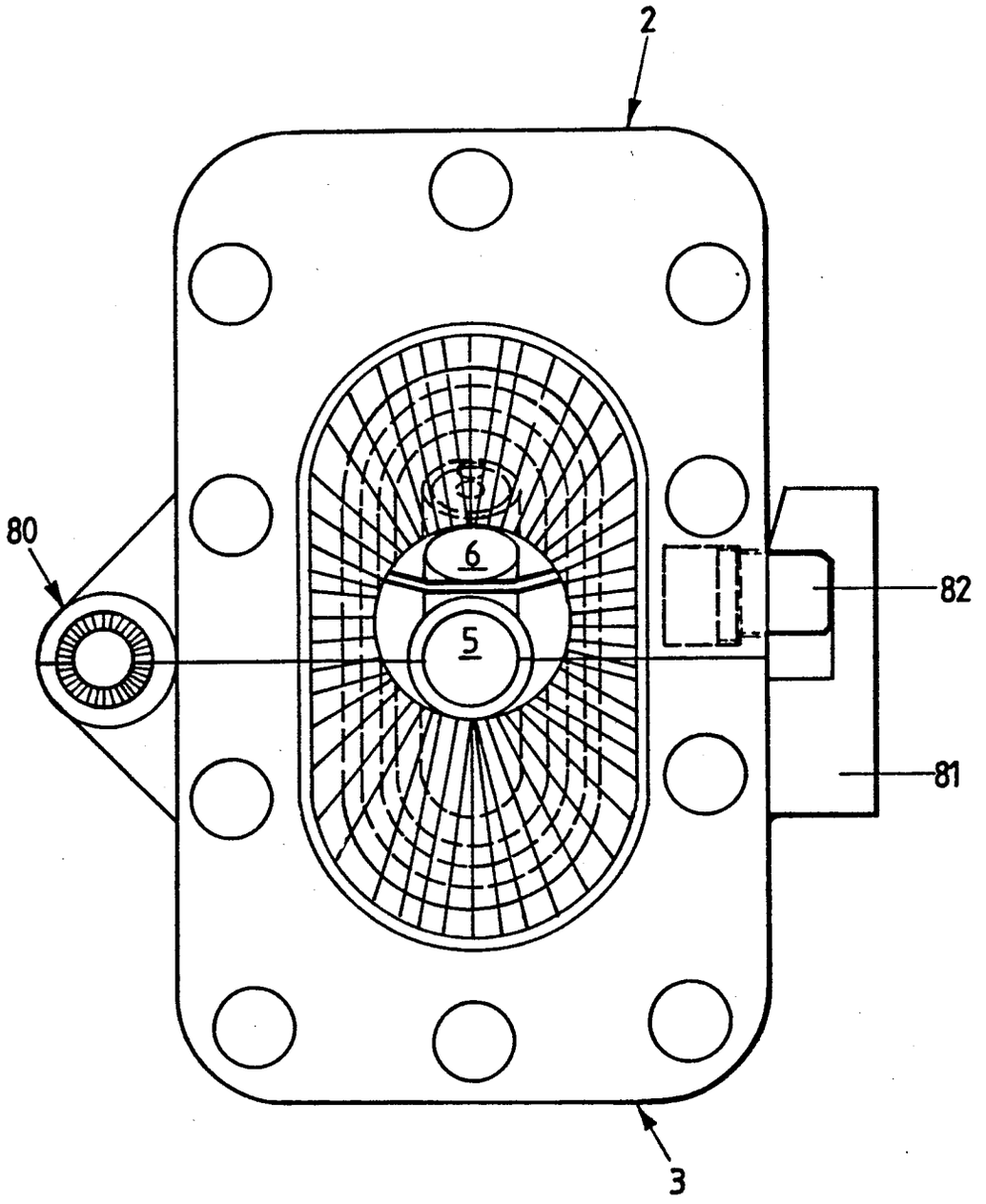

FIG. 4

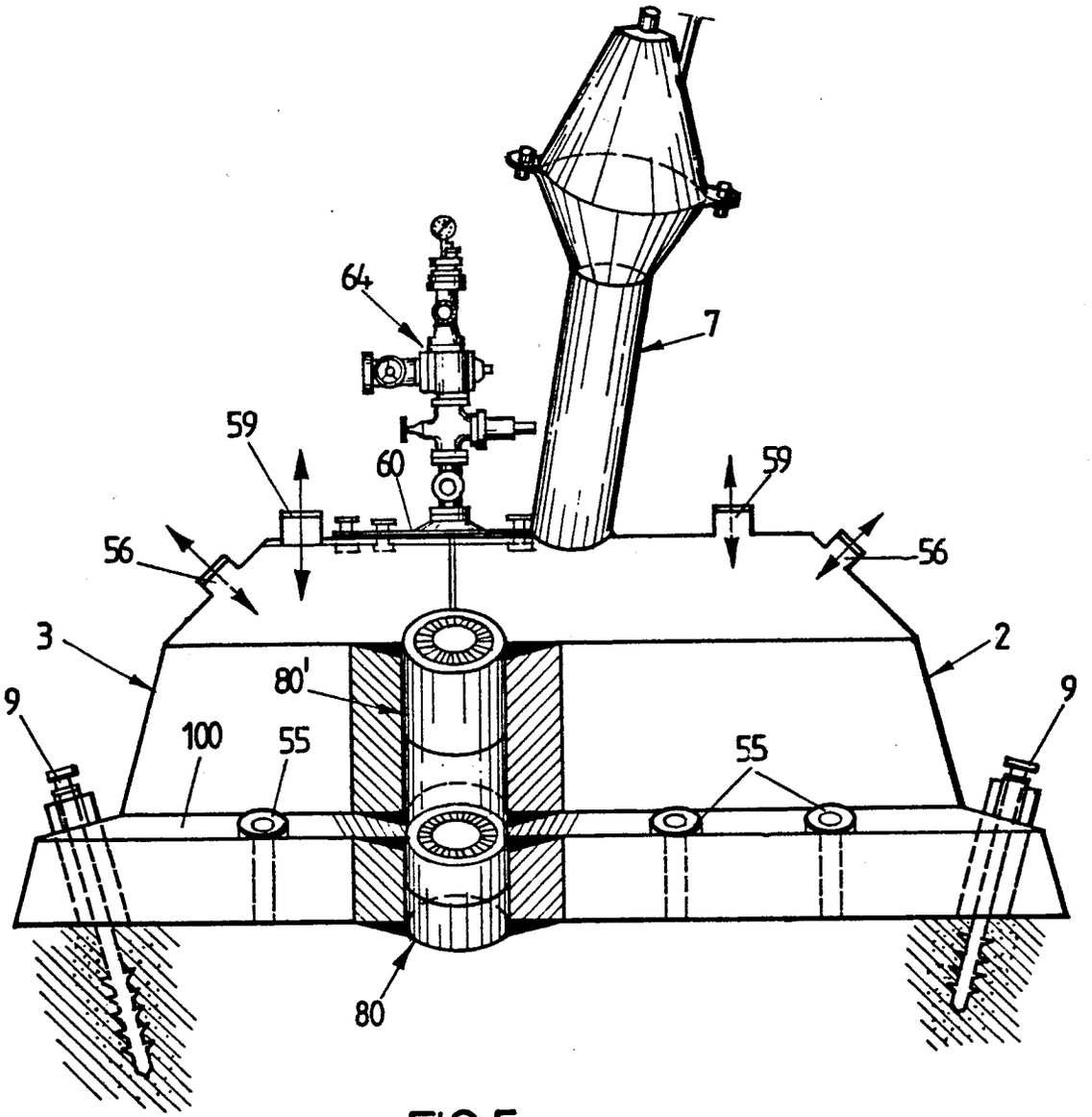

FIG.5

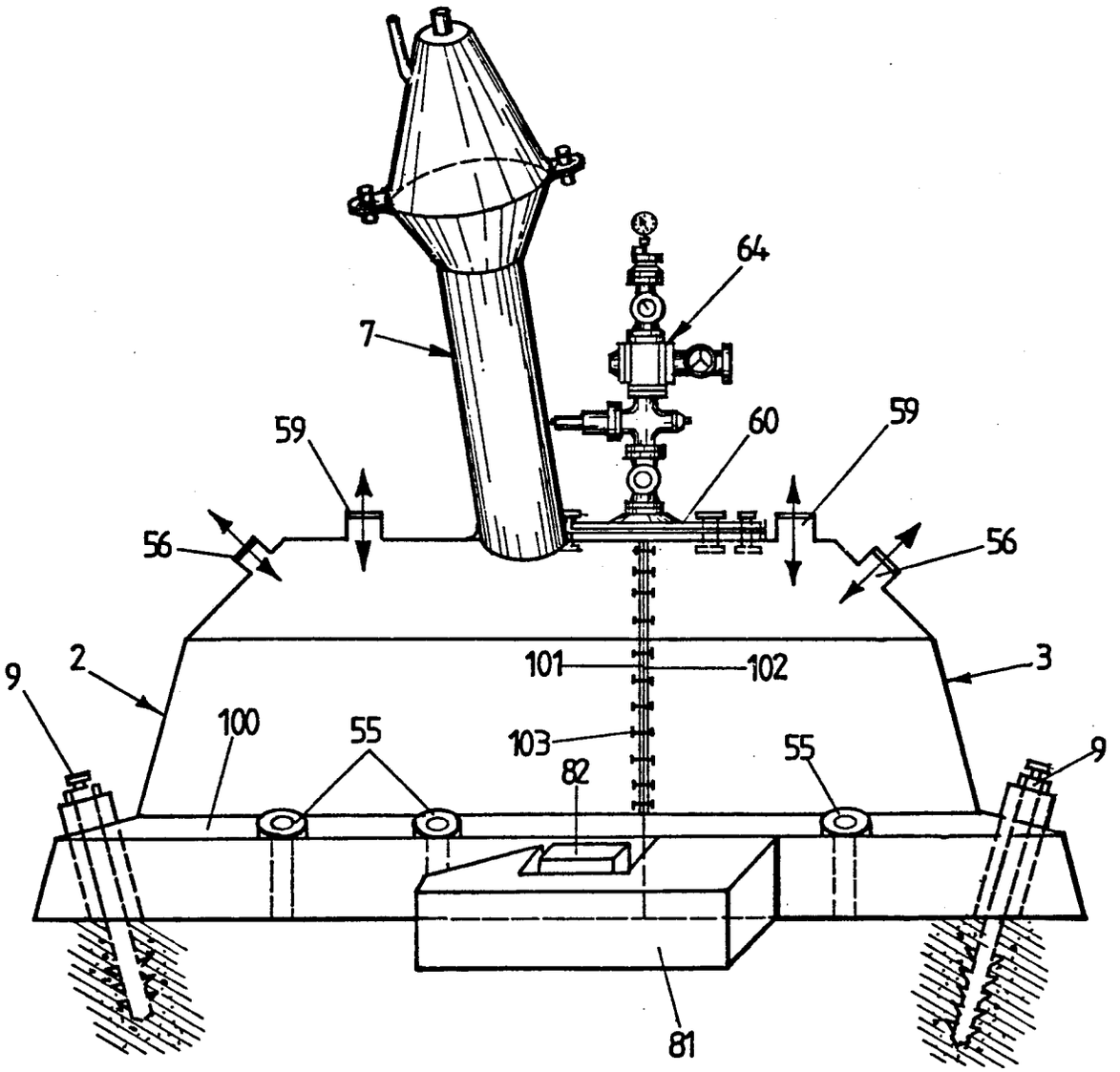

FIG. 6

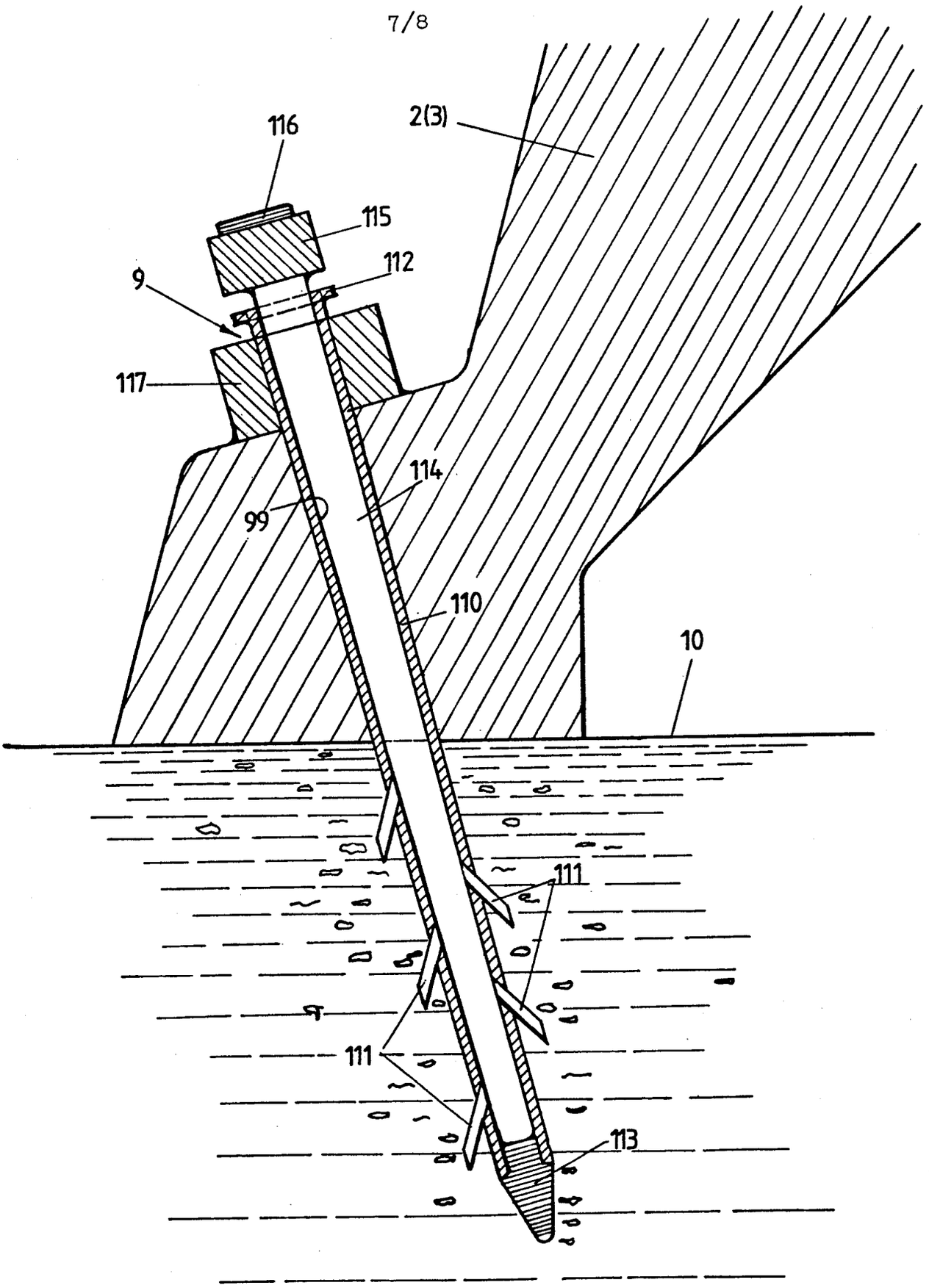

FIG. 7

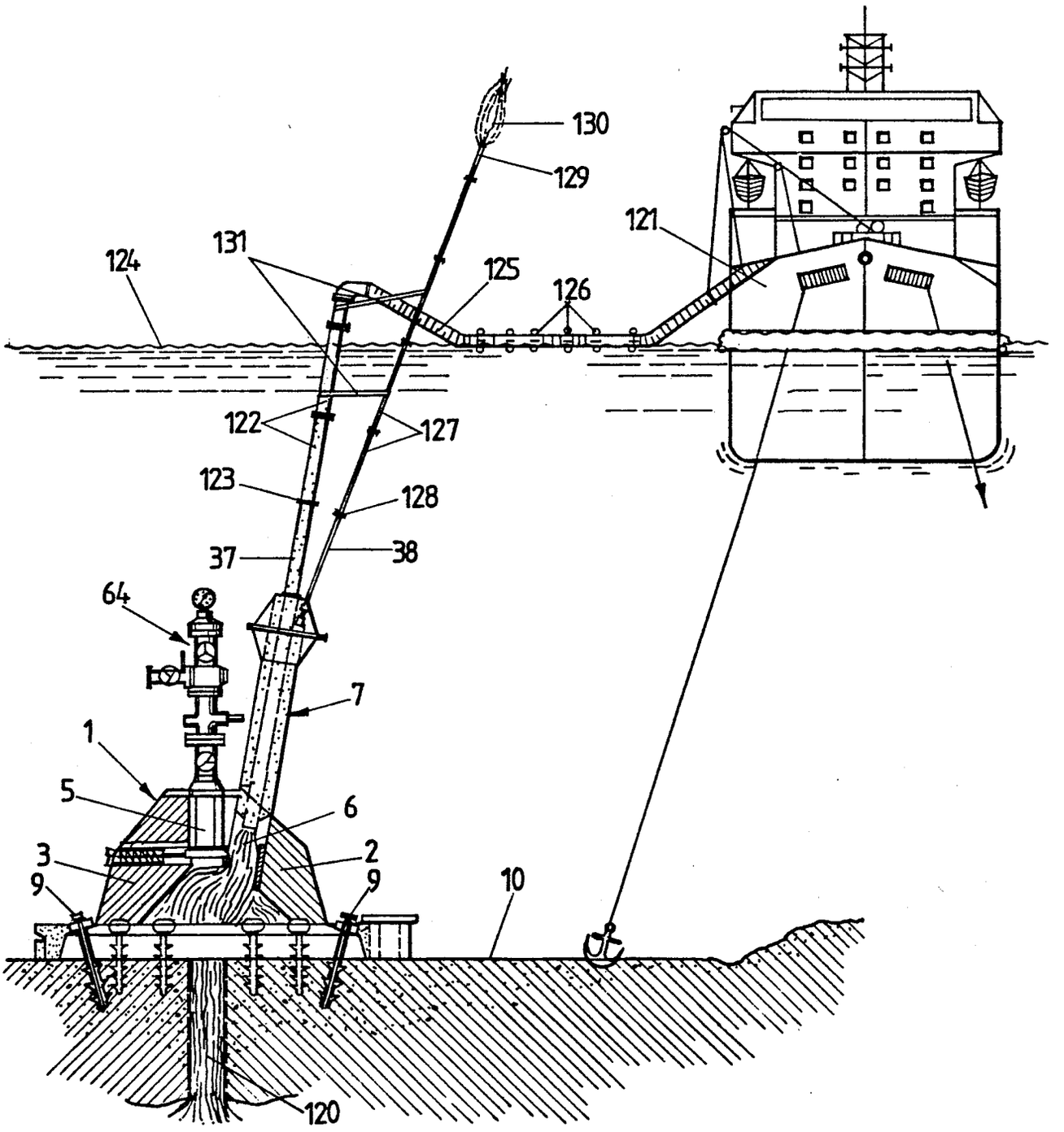
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FIG.8