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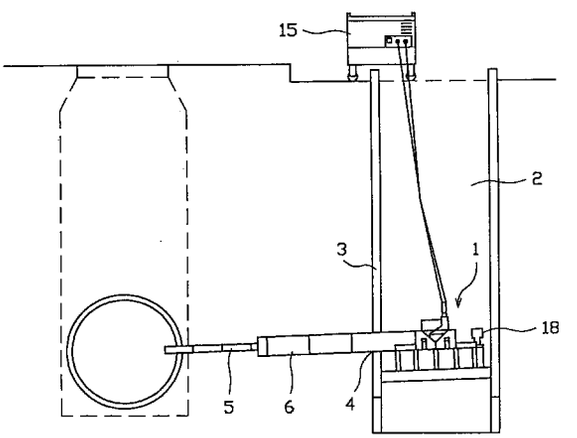
(54) Devices and method to stop water inflow to an underground pipe laying work area

(57) The work area hole in which a pipe laying operation is being carried out has the pass through opening by which pipe lengths being laid are passed through to the pipe line course, is sealed against water inflow through that opening with a seal unit encircling the pipe exterior to seal it, the sleeve in turn being inserted in a sleeve fixed to the inside of a hole liner and passing radially therefrom a distance from the liner, the degree of watertightness of the seals being effective to prevent water inflow to the work area.

Fig. 1



EP 0 725 205 A1

Description

BACKGROUND OF THE INVENTION

The present invention relates to sealing devices and sealing method and, more particularly, to devices and method used for sealing an opening in an underground work space wherein an operation for laying underground piping is being carried out to prevent underground source water from flowing into the work space, underground piping construction in which an oil-hydraulic propulsion machine for propelling a horizontal pipe line is arranged in a vertical excavated hole being exemplary of use of the devices and method.

Conventionally in underground pipe laying, a vertical hole for installing a propulsion machine is excavated. A metal liner plate or casing is then arranged on walls of the vertical hole, and the propulsion machine is arranged at a prescribed position in the vertical hole to define a work area. A hole, generally of circular configuration is cut in a wall of the liner so pipe can be propelled therethrough in a horizontal course through the underground region exterior of the work area. Commonly a small-diameter lead will first be propelled blindly into the area where piping is planned. This lead pipe guides an auger screw and the piping. Thereafter, the service pipe line will be propelled, all thus far described being known in the art. Another method of laying down piping involves propelling an auger screw and piping without the use of a lead pipe. The axis of the auger screw is propelled blindly just as in a similar manner as a guide screw.

With the above methods for laying down piping, it is necessary to propel the piping at a depth that allows the laying down of water and sewage pipes. Therefore, in order to install the propulsion machine, it is, of course, necessary to excavate a vertical hole having an appropriate depth. Since a hole must be made horizontally from the vertical hole, it is possible for water saturated in the earth to flow into work area where it interferes with the operation.

OBJECTS AND SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to provide devices and method for stopping water entry to an underground pipe laying operation work area which overcomes the drawbacks of the prior art.

It is a further object of the invention to provide devices for stopping water entry to underground pipe laying work areas which are highly effective to that purpose, simple to employ and readily handled in the work area.

Another object is to provide devices that can become a permanent part of a manhole structure to insure that such space will be kept water free.

It is a still further object of the invention to provide a method for stopping water entry to an underground pipe laying operation work area that provides a safe and comfortable environment for those working therein.

Briefly stated, there is provided that the work area hole in which a pipe laying operation is being carried out and has the pass through opening by which pipe lengths being laid are passed through to the pipe line course, is sealed against water inflow through that opening with a seal unit encircling the pipe exterior to seal it. This seal unit in turn is inserted in a sleeve fixed to the inside of a hole liner and passing radially therefrom a distance from the liner, the degree of watertightness of the seals being effective to prevent water inflow to the work area.

In accordance with these and other objects of the invention, there is provided a sealing assembly for sealing a pipe pass through opening cut in an excavated hole liner so that piping can be propelled from within the excavated hole through the pipe pass through opening in a piping course, such sealing being to prevent water incursion to a liner enclosed work area from an underground water source exteriorly of the work area. The sealing assembly comprises a seal part having a hollow elongated main body with openings at opposite body ends, means for fixing the position of said main body end openings relative to said pass through opening when said main body has been inserted through the pass through opening with one of the body ends in communication with the work area and an opposite end in communication with the underground water source. Means carried on the main body extend radially relatively inwardly therefrom and are operable to tightly conformably engage an external surface of a pipe passing through said seal part thereby to establish a sealing condition around said pipe external surface effective to obstruct a passage of any water present in said underground water source to said work area.

According to feature of the invention, there is further provided a sealing assembly for sealing a pipe pass through opening cut in an excavated hole liner so that piping can be propelled from a liner enclosed work area through the pipe pass through opening in a piping course, the sealing being to prevent water incursion to the work area from an underground water source exteriorly of the work area. The sealing assembly comprises a sleeve having a radially outwardly directed flange at an end of the sleeve, the sleeve being insertable into the pass through opening from within the work area to engage the said end flange against portions of the liner adjacent the pass through opening. The sleeve carrying a radially inwardly directed ring of a flexible waterproof packing material proximal a sleeve opposite end, there being means securing the said sleeve flange to said liner portions. A seal unit including a hollow cylindrical main body, a radially outwardly directed flange carried at an end of said main body is provided. A section of said main body adjacent an opposite main body end tapers radially inwardly toward the main body opposite end. The seal unit is insertable, tapered end first in said sleeve with the tapered main body with the main body

flange end in following position so said flange can be caused to engage with a radially inwardly directed abutment or stop on the sleeve thereby to effect an insertion stopping of the seal unit. In this position, the said opposite main body end is in communication with the underground water source and the flange carrying end of the main body is in communication with the work area, the ring of flexible waterproof packing material carried in said sleeve having a normal ring inner dimension smaller than an external dimension of the seal unit main body so that when the seal unit is inserted in the sleeve, the ring of waterproof material deforms in close conforming ring course encircling contact with the external surface of the main body effective to obstruct a passage of water from one to an opposite side of the encircling ring course. Seal means are carried internally in the main body and extend radially inwardly therein and engage tightly conformably with an external surface of a pipe passing centrally through the seal unit to establish a seal condition about the external surface of the pipe effective to obstruct a passage of any water present in said underground water source along said pipe external surface to said work area.

According to a still further feature of the invention, there is still further provided a method for sealing a pipe pass through opening cut in an excavated hole liner so that piping can be propelled from a liner enclosed work area through the pipe pass through opening in a piping course without there occurring water incursion to the work area from an underground water source exteriorly of the work area. This method comprises inserting a sleeve having a radially outwardly directed annular flange at a sleeve end and having a flange diameter greater than a largest pass through opening dimension, outwardly from the work area through the pass through opening until the annular flange engages liner surface portions adjacent the pass through opening. The sleeve further has a diametrically disposed barrier of flexible material therein blocking communication between the sleeve flange end and an opposite sleeve end. A ring of a flexible waterproof packing material is carried in the sleeve proximal said sleeve opposite end, this packing material having a normal ring inner dimension of a predetermined value. The sleeve flange is watertightly fixedly secured to the liner surface portions, for example by weldment. An opening is cut in the flexible material in a size slightly smaller than an external dimension of piping to be propelled through the liner opening so that when said piping passes through the said liner opening, the flexible material of the barrier tightly sealingly engages external surface of the piping to prevent any water passage from the water source to the liner space. A seal unit which includes a hollow cylindrical main body, a radially outwardly directed flange carried at an end of the body, and a tapered section at an opposite body end is then inserted into the sleeve tapered section first and concentrically encircling piping present in the sleeve and until the flange on the seal unit body engages a stop on the sleeve. An external surface of the seal unit is tightly sealingly engaged by the packing material ring of the sleeve to effect a watertight sealing therebetween, the flexible material barrier cut opening having been further enlarged prior to seal unit insertion to allow such insertion of the seal unit in the sleeve to be effected. The seal unit also carries an internal packing ring of flexible material which tightly sealingly engages the external surface of the piping to effect watertight sealing therebetween. The seal unit body flange is then watertightly secured to the said stop of the sleeve as by welding.

The above, and other objects, features and advantages of the present invention will become apparent from the following description read in conjunction with the accompanying drawings, in which like reference numerals designate the same elements.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a diagrammatic depiction showing apparatus with which underground piping construction can be carried out and the setting in which same operates, use of such apparatus involving in accordance with the invention, employment of a sealing assembly and procedure for stopping water entry to a construction site hole wherein pipe laying is effected;

FIGURE 2 is a perspective view of a propulsion machine part of the Figure 1 apparatus shown in Figure 1 illustrating the several parts of the propulsion machine.

FIGURE 3a is a front elevational view of a first seal unit part of the sealing assembly;

FIGURE 3b is a plan view of the seal unit shown in Figure 3a;

FIGURE 3c is a side elevational view partly in section of the Figure 3a seal unit;

FIGURE 4a is a front elevational view of a second seal unit part of the seal assembly, this second seal unit part being receivable in the first seal unit part;

FIGURE 4b is a side elevational view partly in section of the Figure 4a seal unit;

FIGURE 5 is a vertical sectional view on enlarged scale depicting the reception of the second seal unit part within the first seal unit part and as such are used in sealing a pipe laying access hole cut in the side of a excavation hole against water incursion into the liner structure wherein a pipe propulsion machine is operating;

FIGURES 6a and 6b are respective side elevational and top plan showings of the setting up of the pro-

pulsion machine in an underground positioning within an excavated, liner-lined hole preliminary to commencing piping lay down;

FIGURE 7 is a view similar to Figure 6a but after an access hole has been cut out in the liner and a Figure 3a first seal unit part fitted in the hole cut out but before piping lay down operations have been started;

FIGURE 8 is a fragmentary view on enlarged scale depicting the first seal unit part in the Figure 7 positioning thereof after a lead pipe propulsion hole has been cut in a reinforced packing barrier sheet in the first seal unit part;

FIGURE 9 is a view similar to Figure 7 but after both a lead pipe run and a run of pipe being laid down have been propelled through the first seal unit part in a piping run course directed away from the excavated hole toward a destination hole;

FIGURE 10 is a fragmentary elevational view on enlarged scale showing a rear end of a laid down piping run disposed at the first seal unit part and projecting radially inwardly into the working space enclosed by the casing or liner that was erected in the excavated hole;

FIGURES 11a and 11b, are respectively, showings of initial and intermediate positionings of the second seal unit part when same is received within the first seal unit part;

FIGURE 12 is a view similar to Figure 9 depicting how the second seal unit part is engaged with a support member to propel the said second unit to a final seated assembly positioning within the first seal unit part;

FIGURE 13 is a view like Figure 12 but showing the second seal unit part in fully seated positioning in the first, there additionally being shown a spacer member engaged with the rear end of a last laid down pipe length so said last laid pipe length can be propelled radially to a clearing or homed location exterior of the liner; and

FIGURE 14 is a top plan view showing of the Figure 12 depiction but with the rear end of the last laid pipe length having being propelled to its homed location.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is intended particularly but not exclusively for use in underground piping construction wherein a small-diameter lead pipe is propelled preliminary to lay down of service piping. The following is a summary description of this type of underground piping construction.

Referring to Fig. 1, a vertical hole 2 for installing a propulsion machine 1 is excavated incident the work of laying a pipe line. The walls of vertical hole 2 are covered with metal liner plates or casing 3 (hereinafter, the description of the embodiments will describe only liner plates). It is understood that the lined hole constitutes a work area. The liner prevents surrounding dirt from falling into vertical hole 2 and prevents silt with high water content from flowing in.

A circular hole 4 is cut in liner plate 3 at a position where the service piping is to be installed. In many instances, a lead pipe 5 will be guided blindly into the earth from hole 4 to establish a properly aligned pipe course along which service piping 6 is to be propelled. In certain instances a lead pipe may be dispensed with in favor of direct installation of the service pipe where assured guidance is not a problem. Lead pipe 5 or piping 6 is propelled up to an already laid-down pipe 7, which, e.g., could be a sewer main.

In an other arrangement the pipe line will be directed to a destination hole 8, arranged in a similar manner as vertical hole 2. Thus, circular hole 4 is arranged to be large enough so that pipe 6 can adequately pass through it while being propelled. The orientation of lead pipe 5 or piping 6 should be toward laid-down pipe 7 or destination hole 8. Piping construction is complete when the piping is propelled up to the destination, laid-down pipe 7 or destination hole 8.

Referring to Fig. 2, propulsion machine 1 propels lead pipe 5 or piping 6 and comprises a base 10, gear rails 11 arranged parallel to each other, sliding members 12a, 12b, which slide along the gear rails, and a main unit 13 of the propulsion machine connected to one of the sliding members.

An oil hydraulic cylinder 14 is arranged between sliding members 12a, 12b. Hydraulic cylinder 14 is connected via a hose 16 to an oil hydraulic pressure supply device 15 (Fig. 1). By adjusting oil flow, the interval between sliding members 12a, 12b can be adjusted. A support member 17 is arranged on propulsion machine main unit 13 so that it supports piping 6.

Piping 6 is propelled according to the movement of propulsion machine main unit 13. A transit 18 is arranged on the opposite side of supporting member 17 so that the position of the fore tip end of the lead pipe can be measured via the inside of hollow, cylindrical lead pipe 5. This allows confirmation that lead pipe 5 is moving in a linear fashion.

A direction correcting means 19 is connected to the tip of lead pipe 5 so that the orientation of the propulsion of lead pipe 5 can be corrected. By checking the orientation of the propulsion using the transit and by operating the direction correcting means at the tip, it is possible to control lead pipe 5 direction to the intended destination position.

As described above, it is possible to blindly guide lead pipe 5 at a prescribed orientation and positioning from vertical hole 2 toward destination hole 8, and thus, it is possible to propel piping 6 to a planned configuration under the guidance of lead pipe 5. A screw 9 is connected to the rear end of lead pipe 5. Piping 6 is arranged so that it covers screw 9. By rotating screw 9 while it is propelled, piping 6 is propelled as well along the path of lead pipe 5. Lead pipes 5, which has reached destination hole 8, are removed one after another at destination hole 8. While piping 6 is being propelled, the earth where pipe 6 is embedded is passed through piping 6 via screw 9 and is transported toward the rear.

When piping 6 has been propelled to the prescribed position, screw 9 is removed and piping 6 is emptied of any dirt therein resultant from the auger operation and pipe propelling. In this way, piping 6 is laid down underground.

If the earth has a high water content, a water-stopping plug can be used to seal the tip of piping 6, thus preventing the earth from flowing into piping 6. In cases such as these, screw 9 would not be used. Also, when piping is to be laid to connect to laid-down pipe 7, lead pipe 5 described above would not be used. Direction correcting means 19 would be connected to the tip of screw 9 and piping 6 would be propelled while the direction correction is performed. The procedure of removing lead pipes 5 is not required as in the case when the piping is to reach destination hole 8, and screw 9 is brought back to vertical hole 2 after the propulsion of piping 6.

The present invention provides devices for use in underground piping construction as described above with a device to prevent water and earth from flowing into vertical hole 2 from hole 4 arranged On liner plate 3 as well as a method for achieving the same.

Referring to Figs 3-5, the following is a description of an embodiment of the water-stopping device. The water-stopping device of this embodiment comprises a first water-stopping means or sleeve, and a second water-stopping means or seal unit.

The first water-stopping means 20 includes has a main unit 21 or sleeve of generally cylindrical shape whose outer diameter is smaller than the diameter of hole 4 so that it can pass through hole 4. A ring-shaped connecting section 23 is arranged on a rim 22 on one end of main unit or sleeve 21 of the first water-stopping means. Connecting section 23 is arranged so that it projects outward radially. Connecting section 23 serves to connect liner plate 3 (Fig. 1), which is arranged in the inside surface of the vertical hole excavated in a circular cross-section, and first water-stopping means main unit 20.

Thus, it is shaped in a ring-shape, viewed from the front (Fig. 3a), in an arc shape viewed from the top (Fig. 3b), and in a bow shape viewed from the side (Fig. 3c) so that same conforms to the inner surfaces of the liner portions adjacent hole 4. This allows the surface of connecting section 23 to be in firm contact with the surface of liner plate 3 when first water-stopping means main unit 21 is passed through hole 4.

A ring-shaped support plate 25 projecting inward radially of the sleeve is connected thereto and is arranged on an end rim 24 at the end opposite from connecting section 23 on first water-stopping means main unit 21.

A ring-shaped fixing plate 26 is connected opposite to support plate 25 with a bolt 27 and a nut 28. Ring-shaped rubber packing 29 is interposed between support plate 25 and fixing plate 26 and is supported by bolt 27, which passes through it. Reinforcement packing elements 30, 31 are supported in a similar manner by bolt 28. One of these two, reinforcement packing 30 has a ring shape and has an inner diameter that matches or is slightly smaller than the outer diameter of piping 6 (Fig. 1). The other packing, reinforcement packing 31, is formed in a circular plate shape.

Both reinforcement packing 30, 31 are thin enough to be cut easily with a blade. During construction, these are cut bit by bit. Rubber packing 29 and reinforcement packing 30, 31 are all squeezed tightly between support plate 25 and fixing plate 26 by bolt 27 and nut 28.

The following is a description of the second water-stopping means. Referring to Fig. 4, second water-stopping means or seal unit 40 has a main unit 41 formed in a cylindrical shape. Its outer diameter is slightly smaller than the inner diameter of support plate 25 (Fig. 3) arranged on first water-stopping means 20, and is larger than the inner diameter of rubber packing 29 (Fig. 3), so that it can be fit into first water-stopping means 20.

A fitting fore section or tip 42 of second water-stopping means main unit 41 has a tapered section 43 that is connected to main unit 41. Tapered section 43 is hollow and of conical or truncated conical and has an outer surface that is formed with a sharp taper. Tapered section 43 is made to fit easily into the first water-stopping means sleeve 20.

Connecting section 43 projects radially outward at opposite end rim 44. The outer diameter of connecting section 43 is formed slightly larger than the inner diameter of support plate 25 (Fig. 3) of first water-stopping means 20. Thus, when second water-stopping means 40 is fit into first water-stopping means 20 via tapered section 43, connecting section 45 of second water-stopping means 40 presses against support plate 25 of first water-stopping means 20.

Ring-shaped support plate 46 projects inward radially at an appropriate position inside second water-stopping means main unit 40. A pressure piece 47 is arranged inside tapered section 43 so that it projects radially.

Rubber packings 48, 49 is arranged between support plate 46 and pressure piece 47. Rubber packings 48,49 are fixed after they are positioned at the appropriate position by pushing in a ring-shaped elastic piece 50 at the gap between rubber packing 48, 49 and pressure piece 47. Rubber packings 48, 49 are pressed firmly by support plate 46 so their position is fixed.

Referring to Fig. 5, first water-stopping means 20 and second water-stopping means 40 provide adequate water stoppage when second water-stopping means 40 is fit into first water-stopping means 20. Furthermore, when connecting section 45 of second water-stopping means 40 is pressed against support plate 25 of first water supporting means 20, then an open space having a diameter larger than that of piping 6 is formed inside first water-stopping means 21. This permits support member 17 (Fig. 2) of propulsion device 1 to be used in this open space, and allows the rear end of piping 6 to be pushed into a position in front of the rear end of first water-stopping means 20 (to the left in the drawing). Thus, since piping 6 does not project inward in vertical hole 2 (Fig. 1) after it has been laid down, the space in vertical hole 2 can be used effectively.

Referring to Figs. 6-14, the following is a description of the water-stopping method using the water-stopping device described above. As described above, in underground piping construction, vertical hole 2 is excavated to install propulsion machine 1. A metal liner plate 3 is arranged on the walls of the hole. Hole 4 is made in liner plate 3, and this hole 4 is cut at a position corresponding to the propulsion orientation of lead pipe 5 and piping 6.

Referring to Fig. 6, chemicals such as drying agents or coagulating agents are injected into the earth as ground solidifying components at an area containing planned hole B. Planned hole B is the area where the hole is planned, and has a larger diameter than circle A, which is the area where piping 6 will pass through.

The injection of the chemicals solidifies the earth, thus preventing earth from flowing in even when planned hole B is opened. The injection of the chemicals can be performed by injecting the chemicals over a wide area initially when vertical hole 2 is being excavated. The chemicals can also be injected through a small hole that is punched in liner plate 3 when hole 4 is being made. While the earth is dried out from the drying agent, hole 4 is made by cutting away the planned hole area in liner plate 3.

Hole 4 is formed to pass through piping 6 (Fig. 1), and it is formed with a circular shape. The center of hole 4 is arranged so that it matches the center of the axis of the piping propelled by propulsion machine 1.

Referring to Fig. 7, while the earth is in a dried-out state due to the chemical injection, first water-stopping means 20 is attached to hole 4. Since first water-stopping means 20 is attached so that it projects into the earth from liner plate 3, the earth that is in the area of this projection is removed before attachment. First water-stopping means 20 is attached by putting connection section 23 on main unit 21 into contact with liner plate 3 and welding the two together. Since reinforcement packing 31 is in a circular plate shape as described above, it acts as a flow block and hole 4 is kept sealed. Thus, even if the effectiveness of the chemicals injected around hole 4 decreases, earth would not flow into vertical hole 2.

Referring to Figs. 8 and 9, reinforcement packing 31 is cut where lead pipe 5 will pass through, and a lead pipe propulsion hole 32 is made. At this point lead pipe propulsion hole 32 is the only section that is open. Next, lead pipe 5 is attached to propulsion machine 1, and lead pipe 5 is passed through lead pipe propulsion hole 32 and propelled blindly into the earth.

The procedure by which this blind propulsion occurs is as follows. Lead pipe propulsion hole 32 is sealed and prevents earth from flowing into vertical hole 2 while lead pipe 5 is being inserted. Once the blind propulsion of lead pipe 5 is complete, the section in reinforcement packing 31 where piping 6 passes through is removed and pipe propulsion hole 33 is made. Piping 6 is attached to propulsion machine 1 and the propulsion of piping 6 begins. At this point, piping propulsion hole 33 of reinforcement packing 31 is open, but while piping 6 is inserted into piping propulsion hole 33 the remaining parts of reinforcement packing 31 and the surface of piping 6 are in contact, and earth is prevented from flowing into vertical hole 2.

When screw 9 is used as described above (Fig. 2), earth is passed through the opening at the leading piping 6 so that the piping can move forward. When propulsion of piping 6 is completed by having piping 6 propelled up to laid-down pipe 8 or destination hole 9 (Fig. 1), then screw 9 within piping 6 is pulled back into vertical hole 2, thus emptying the insides of piping 6. This completes the process of laying down the piping.

Referring to Fig. 10, water is prevented from flowing into the vertical hole by first water-stopping means 20, since reinforcement packing 30, 31 are pressed against the outer surface of piping 6, while rubber packing 29 is not pressed against piping 6. Thin reinforcement packing 30, 31 are pressed against piping 6 when it is propelled because it is necessary to maintain low friction with the outer surface of piping 6 while maintaining appropriate water blockage. Thus, water can not be blocked over a long period of time in this state. Therefore, second water-stopping means 40 is fitted between piping 6 and rubber packing 29.

The following is a description of the fitting of the second water-stopping means. Referring to Fig. 11a, second water-stopping means 40 is arranged so that tapered section 43 is oriented toward the propulsion and so that piping 6 is passed through the hollow area inside second water-stopping means main unit 41, which is cylindrical in shape. Referring to Fig. 11b, second water-stopping means 41 is propelled slowly in the propulsion direction. Referring to Fig. 12, propulsion machine 1 is used for this propulsion.

Propulsion machine 1 is dedicated to the propulsion of lead pipe 5 and piping 6, so support member 17 (Fig. 2) is made to match the size of piping 6. Since second water-stopping means main unit 41 is larger than piping 6, it is necessary to replace the standard support member 17 (Fig. 2) with a dedicated support member 51. When preparations for propelling second water-stopping means main unit 41 is complete, either reinforce-

ment packing 30, 31 are removed or ring-shaped rubber packing 29 is cut so that it forms a diameter that is larger than the inner diameter. At the same time as reinforcement packing 30, 31 is cut, second water-stopping means 40 is propelled and is fitted inside first water-stopping means 20.

Referring to Fig. 12, at this time tapered section 42 arranged on second water-stopping means main unit 41 is able to be propelled while pushing rubber packing 29 of first water-stopping means 20 wider. This allows easy fitting of second water-stopping means 40.

Referring to Fig. 13, it is seen that by propelling second water-stopping means 40, it is possible to press the connecting section of second water-stopping means main unit 41 to support plate 25 of first waterstopping means 20. In this state rubber packing 29 of first water-stopping means 20 presses against the outer surface of second water-stopping means 41 so that water is adequately prevented from coming in between them. Also, rubber packing 48, 49 of second water-stopping means 40 presses against the outer surface of piping 6 so that water is adequately prevented from coming in between them. Then, while this state is maintained, the connecting section of second water-stopping means main unit 41 and support plate 25 of first water-stopping means 20 are welded together and fixed. This forms liner plate 3 and first water-stopping means 20 and second water-stopping means 40 into an integral unit, and it allows the entire vertical hole 2 to be used later as a manhole.

Referring to Fig. 14, finally, a rear or rearmost end 6a of piping 6 projects greatly from the inside surface of liner plate 3 inward into vertical hole 2. Piping 6 is propelled so that rear end 6a of piping 6 is positioned further underground than the inner surface of liner plate 3. A dedicated spacer 52 is attached between support member 17 of propulsion machine 1 and piping rear end 6a. Dedicated spacer 52 is formed in a cylindrical shape and has a diameter the same size as the diameter of piping 6. The rear end of spacer 52 engages with supporting member 17 of propulsion machine 1, while the front end engages with piping 6. Therefore, when propulsion machine main unit 13 is moved forward, propulsion can take place without any contact with first water-stopping means 20 or second water-stopping means 40. This results in no projection inward into vertical hole 2 and allows free use of the space in vertical hole 2.

As described above, piping 6 is propelled in a fixed direction from vertical hole 2, and it is also can propel another pipe in the opposite direction. In this case, since the direction of propulsion machine 1 has to be reversed, but since rear end 6a of the piping (which has already been propelled) does not project into vertical hole 2, it is possible to easily change direction.

Having described preferred embodiments of the invention with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention as defined in the appended claims. For example, the shape of the vertical hole and the installation of the liner plate are generally determined. Modifications in these aspects do not change the present invention.

Claims

1. A sealing assembly for sealing a pipe pass through opening cut in an excavated hole liner so that piping can be propelled from within the excavated hole through the pipe pass through opening in a piping course, such sealing being to prevent water incursion to a liner enclosed work area from an underground water source exteriorly of the work area, said sealing assembly comprising

   a seal part having a hollow elongated main body with openings at opposite body ends, means for fixing the position of said main body end openings relative to said pass through opening when said main body has been inserted through the pass through opening with one of the body ends in communication with the work area and an opposite end in communication with the underground water source, and

   means carried on the main body extending radially relatively inwardly therefrom and operable to tightly conformably engage an external surface of a pipe passing through said seal part thereby to establish a sealing condition around said pipe external surface effective to obstruct a passage of any water present in said underground water source to said work area.

2. A sealing assembly in accordance with claim 1 in which the main body openings position fixing means comprises a flange on said main body extending radially outwardly from an end thereof, said flange when the main body is inserted through the pass through opening engaging in stopped abutment with portions of the liner adjacent the pass through opening at locations where said flange can be secured to said liner portions.

3. A sealing assembly in accordance with claim 2 in which the sealing establishing means comprises a flexible waterproof packing material.

4. A sealing assembly in accordance with claim 1 in which the main body openings position fixing means comprises a sleeve insertable in the pass through opening and having a flange extending radially outwardly of the sleeve at an end thereof for engaging in stopped abutment with portions of the liner adjacent the pass through opening, the sleeve carrying at least one flexible resilient radially inwardly extending packing element defining a socket for reception of the seal part main body, the packing element closely tightly conformingly encir-

cling an external surface of the said seal part main body in a seal course contact therewith effective to obstruct a passage of water from one to an opposite side of the seal course, the sleeve including radially inwardly directed structure presenting a stopping abutment to a radially outwardly directed flange carried at an end of said seal part main body.

5. A sealing assembly in accordance with claim 4 in which a length section of said seal part main body adjacent a main body opposite end tapers inwardly of a remainder length of said seal part main body.

6. A sealing assembly for sealing a pipe pass through opening cut in an excavated hole liner so that piping can be propelled from a liner enclosed work area through the pipe pass through opening in a piping course, such sealing being to prevent water incursion to the work area from an underground water source exteriorly of the work area, said sealing assembly comprising

a sleeve having a radially outwardly directed flange at an end of the sleeve, the sleeve being insertable into the pass through opening from within the work area to engage the said end flange against portions of the liner adjacent the pass through opening, the sleeve carrying a radially inwardly directed ring of a flexible waterproof material proximal a sleeve opposite end, there being means securing the said sleeve flange to said liner portions,

a seal unit including a hollow cylindrical main body, a radially outwardly directed flange carried at an end of said main body, a section of said main body adjacent an opposite main body end tapering radially inwardly toward said main body opposite end, said seal unit being insertable in said sleeve with the tapered main body end in a leading position with the main body flange end in following position so said flange can be caused to engage with a radially inwardly directed abutment on the sleeve thereby to effect an insertion stopping of the seal unit wherein the said opposite main body end is in communication with the underground water source and the flange carrying end of the main body is in communication with the work area, the ring of flexible waterproof material carried in said sleeve having a normal ring inner dimension smaller than an external dimension of the seal unit main body so that when the seal unit is inserted in the sleeve, the ring of waterproof material deforms in close conforming ring course encircling contact with the external surface of the main body effective to obstruct a passage of water from one to an opposite side of the encircling ring course, and

seal means carried internally in said main body extending radially inwardly therein and engageable tightly conformably with an external surface of a pipe passing centrally through the seal unit for establishing a seal condition about the external surface of the pipe effective to obstruct a passage of any water present in said underground water source along said pipe external surface to said work area.

7. A sealing assembly in accordance with claim 6 in which the sleeve and the evacuated hole liner are metal components, the sleeve flange securing means comprises a weldment securing the said sleeve flange to the liner portions at an inner side of the liner.

8. A sealing assembly in accordance with claim 7 in which the weldment extends in an endless course so that the securement of the said sleeve flange to the liner portions is along a watertight joinder therebetween.

9. A method for sealing a pipe pass through opening cut in an excavated hole liner so that piping can be propelled from a liner enclosed work area through the pipe pass through opening in a piping course without there occurring water incursion to the work area from an underground water source exteriorly of the work area, said method comprising

inserting a sleeve having a radially outwardly directed annular flange at a sleeve end and having a flange diameter greater than a largest pass through opening dimension, outwardly from the work area through the pass through opening until the annular flange engages liner surface portions adjacent the pass through opening, the sleeve further having a diametrically disposed barrier of flexible material blocking communication between the sleeve flange end and an opposite sleeve end, there being additionally a ring of a flexible waterproof packing material carried in the sleeve proximal said sleeve opposite end, the said packing material having a normal ring inner dimension of a predetermined value,

watertightly fixedly securing the sleeve flange to the liner surface portions,

cutting an opening in the flexible material barrier of a size slightly smaller than an external dimension of piping to be propelled through the liner opening so that when said piping passes through the said liner opening, the flexible material of the barrier tightly sealingly engages external surface of the piping to prevent any water passage from the water source to the liner space as,

inserting a seal unit which includes a hollow cylindrical main body, a radially outwardly directed flange carried at an end of the body, and a tapered section at an opposite body end into the sleeve tapered section first and concentrically encircling piping present in the sleeve and until the flange on the seal unit body engages a stop on the sleeve, an external surface of the seal unit being tightly seal-

ingly engaged by the packing material ring of the sleeve to effect a watertight sealing therebetween, the flexible material barrier cut opening having been further enlarged prior to seal unit insertion to allow such insertion of the seal unit in the sleeve to be effected, the seal unit carrying an internal packing ring of flexible material which tightly sealingly engages the external surface of the piping to effect watertight sealing therebetween, and

watertightly fixedly securing the seal unit body flange to the said stop.

10. The method of claim 9 in which the liner, sleeve and seal unit are metallic components and the fixed securement of the sleeve to the liner and the seal unit to the sleeve comprises weldments.

11. The method of claim 9 in which prior to inserting the sleeve through the liner opening, ground solidifying agents are injected into ground exterior of the liner at least in ground regions proximal the location of the opening in the liner thereby to inhibit passage of ground material through the said opening an into the work area.

12. The method of claim 9 further comprising recessing a terminal end of propelled piping at a location radially outwardly of an inner surface of the liner.

FIG. 1

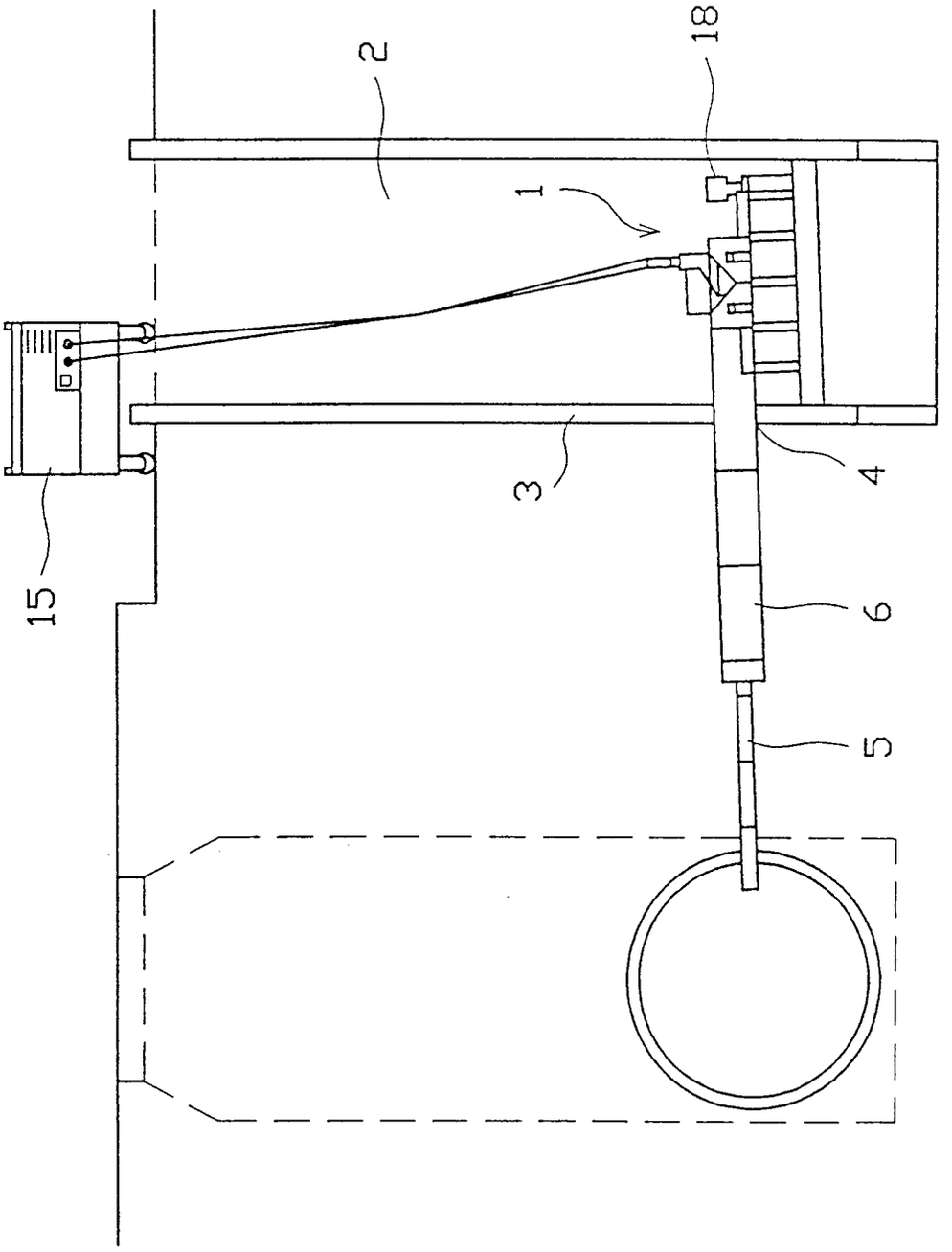


FIG. 2

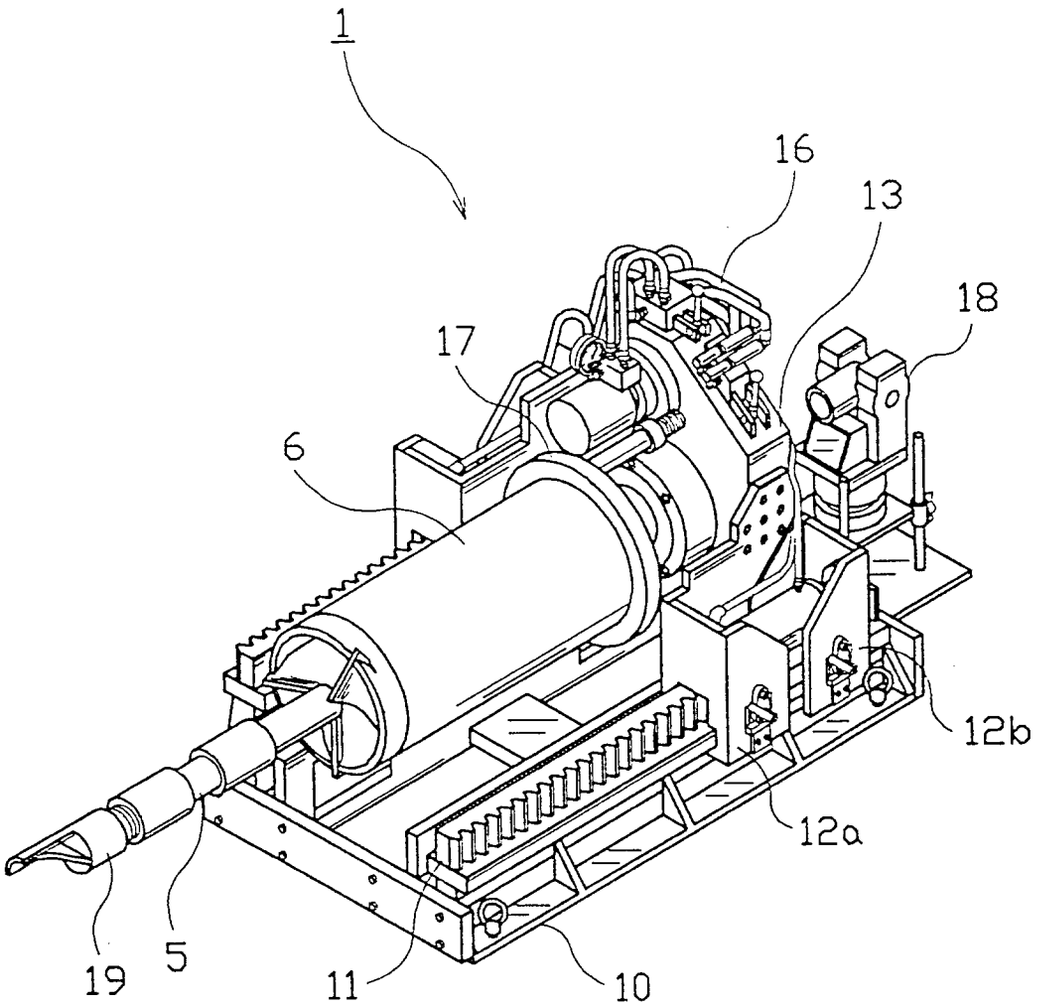


FIG.3a

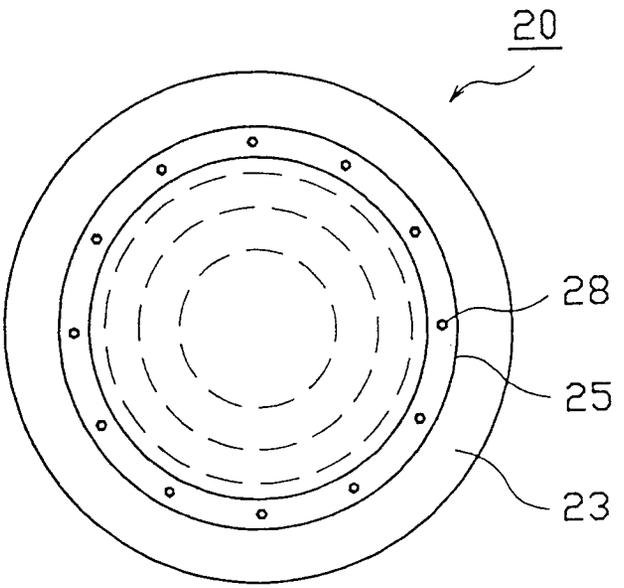


FIG.3b

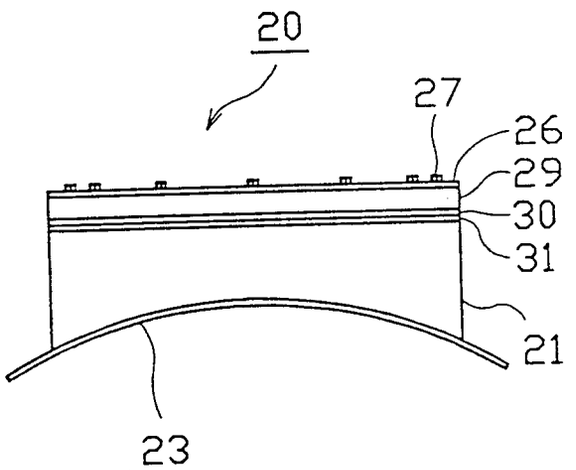


FIG.3c

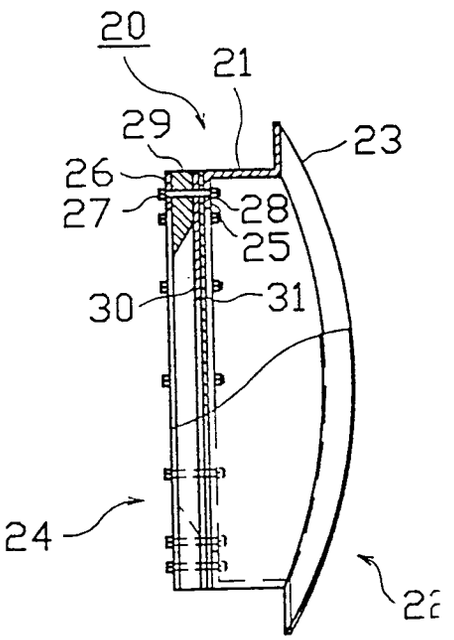


FIG. 4a

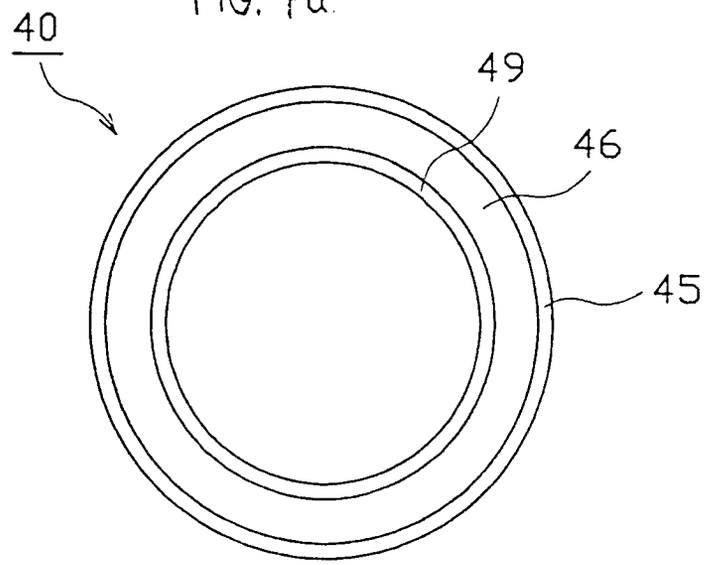


FIG. 4b

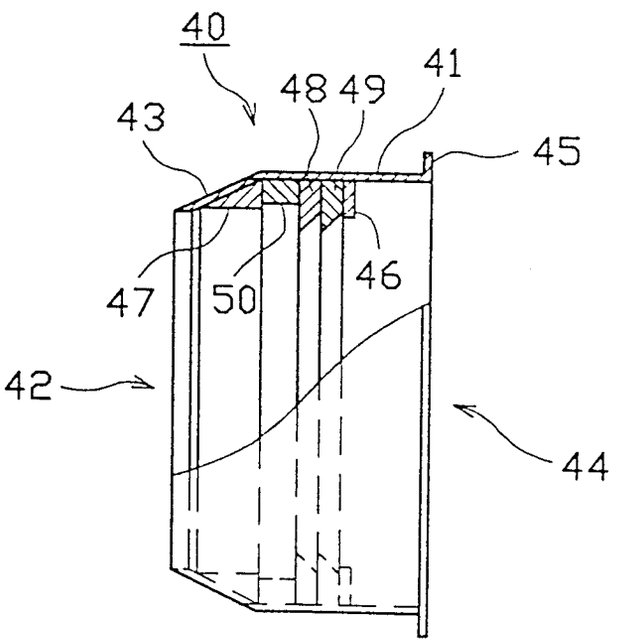


FIG.5

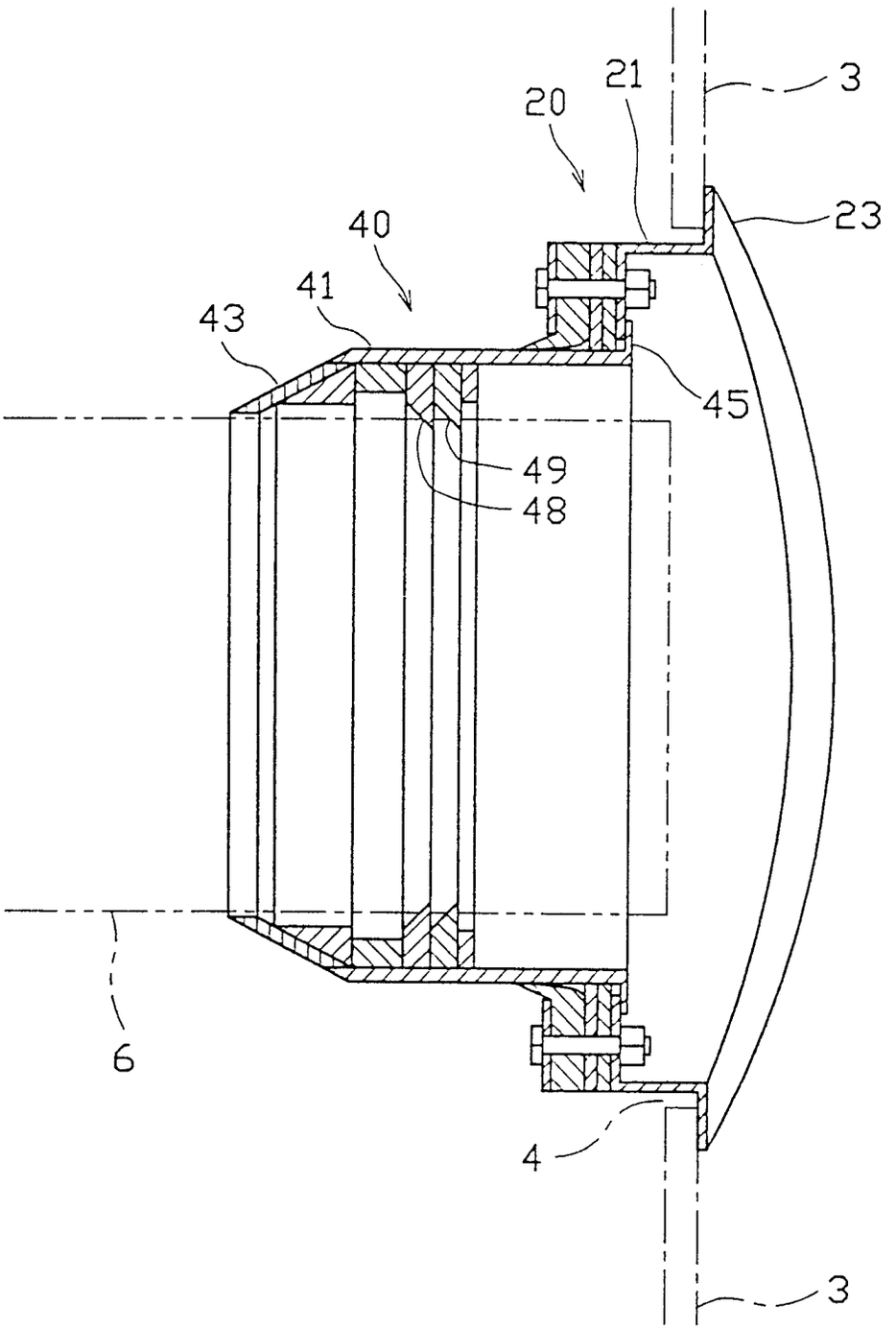


FIG.6a

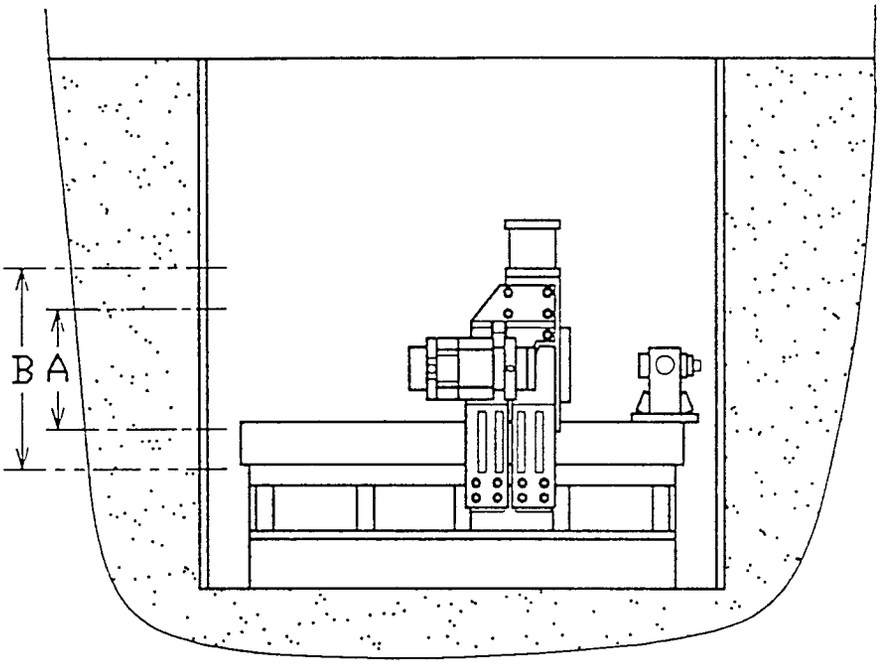


FIG.6b

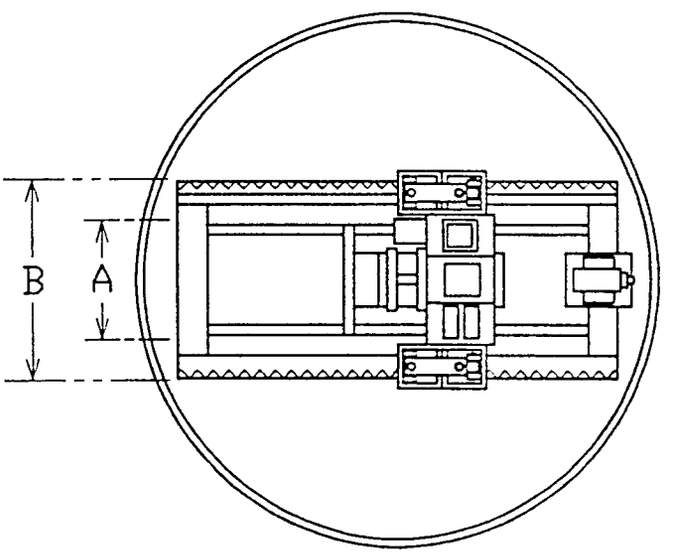


FIG. 7

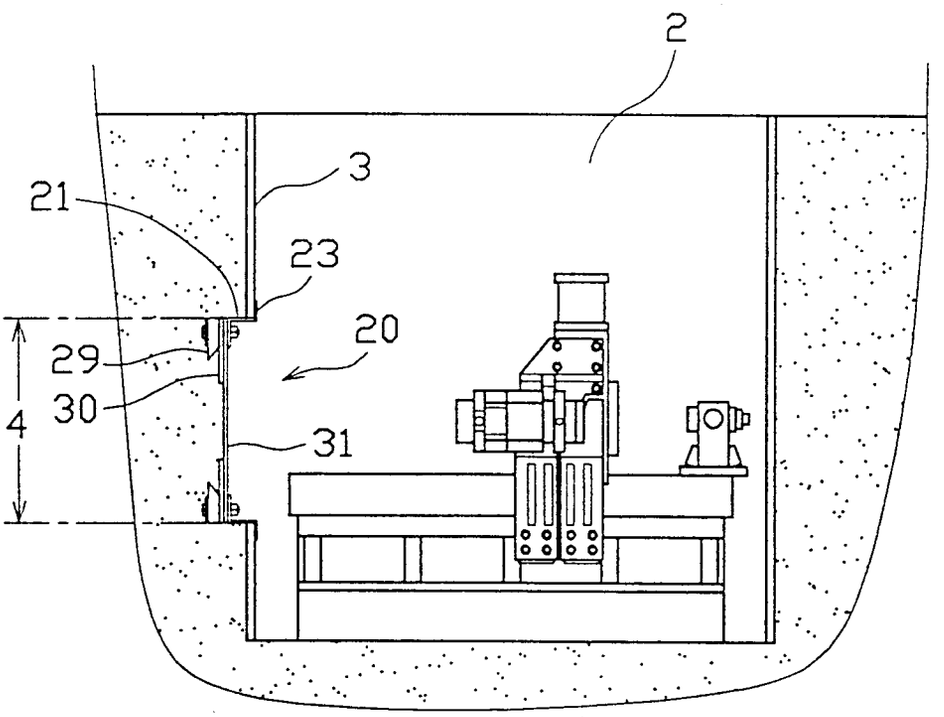


FIG. 8

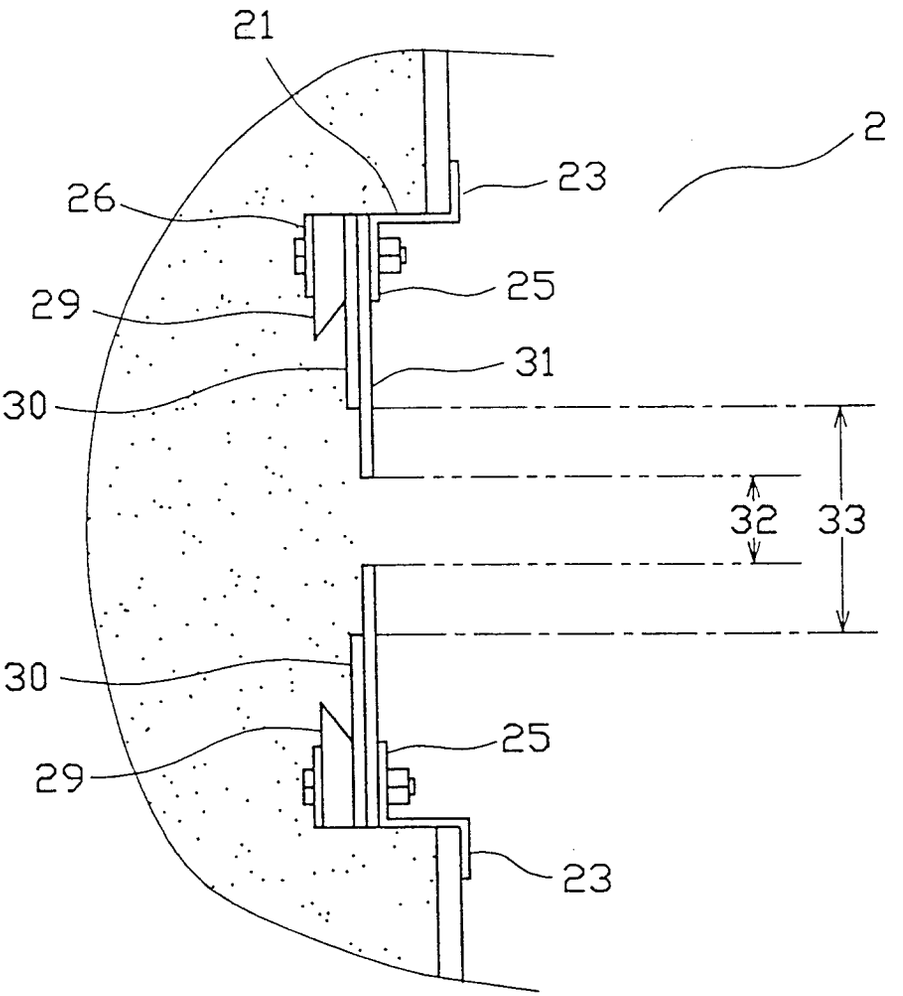


FIG. 9

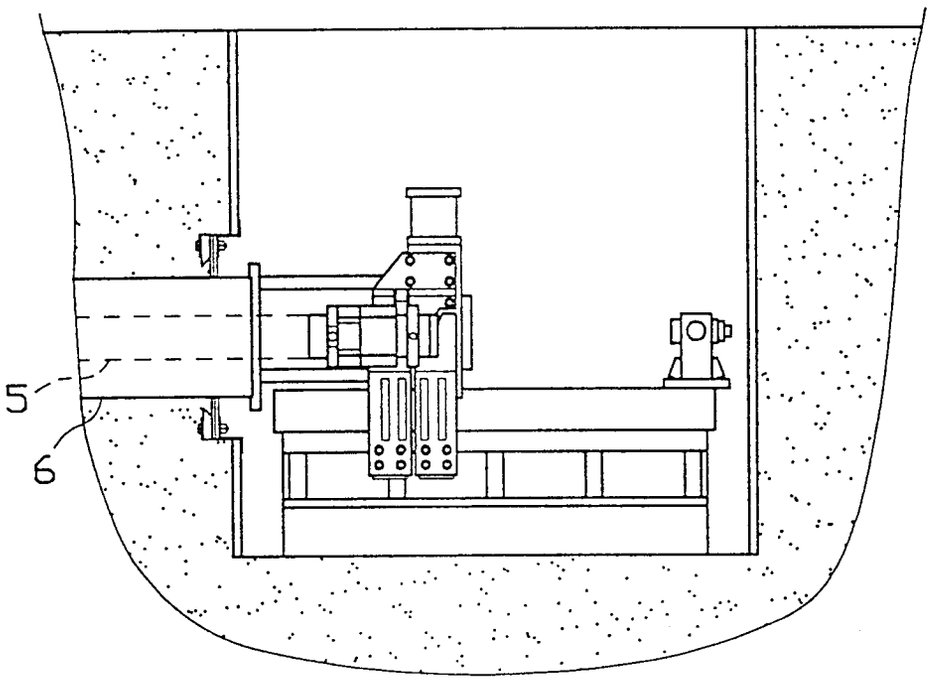


FIG. 10

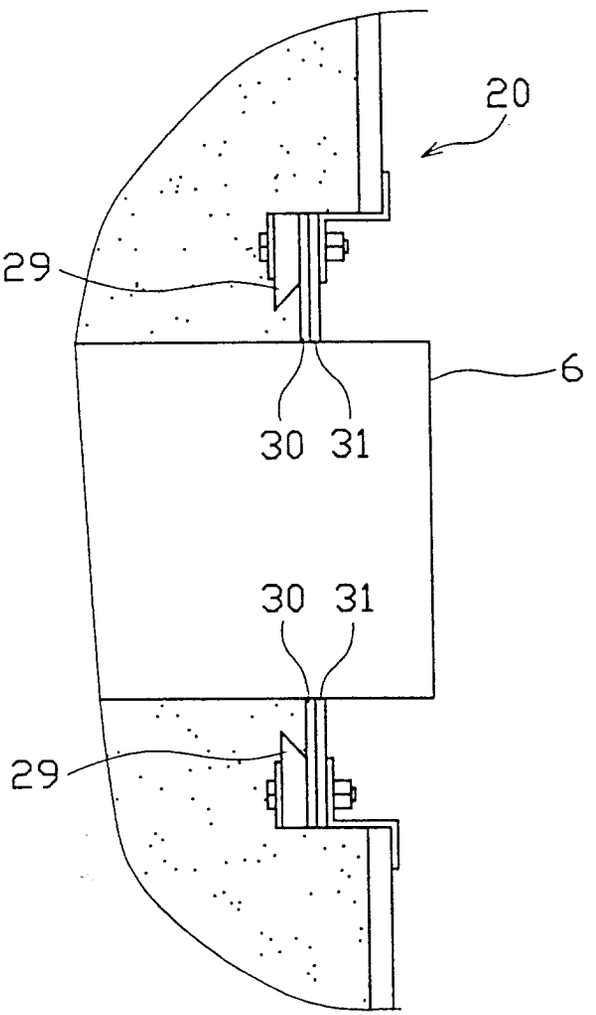


FIG 11a

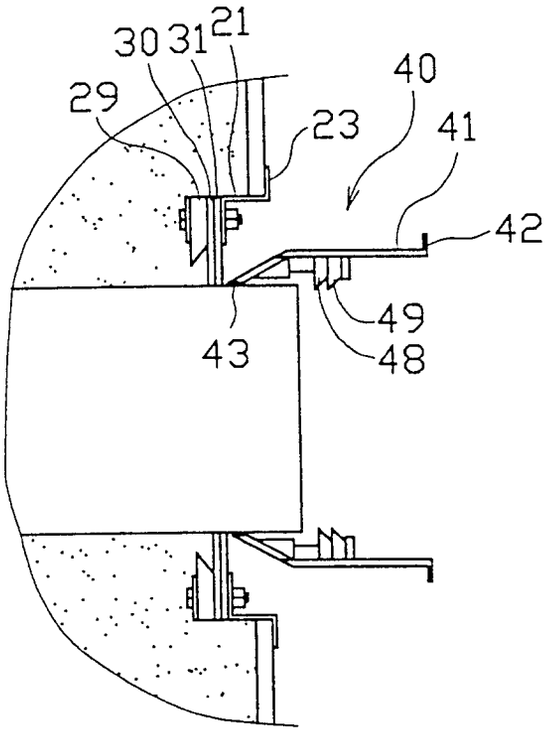


FIG. 11 b

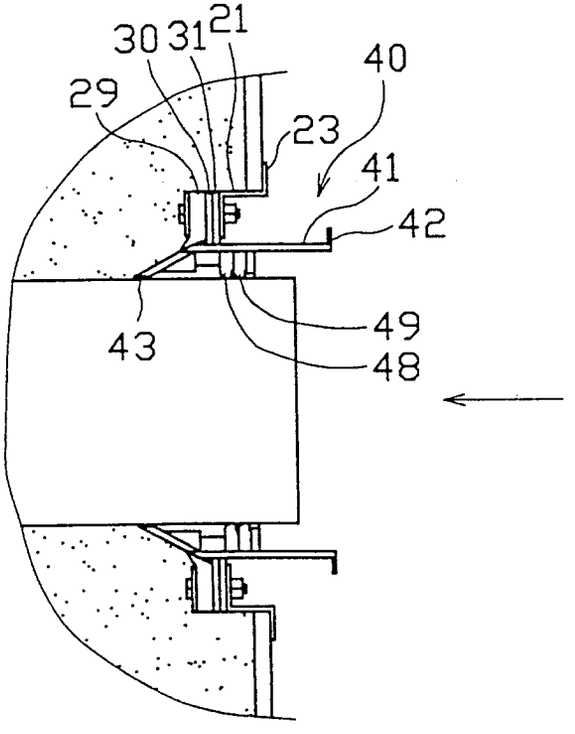


FIG. 12

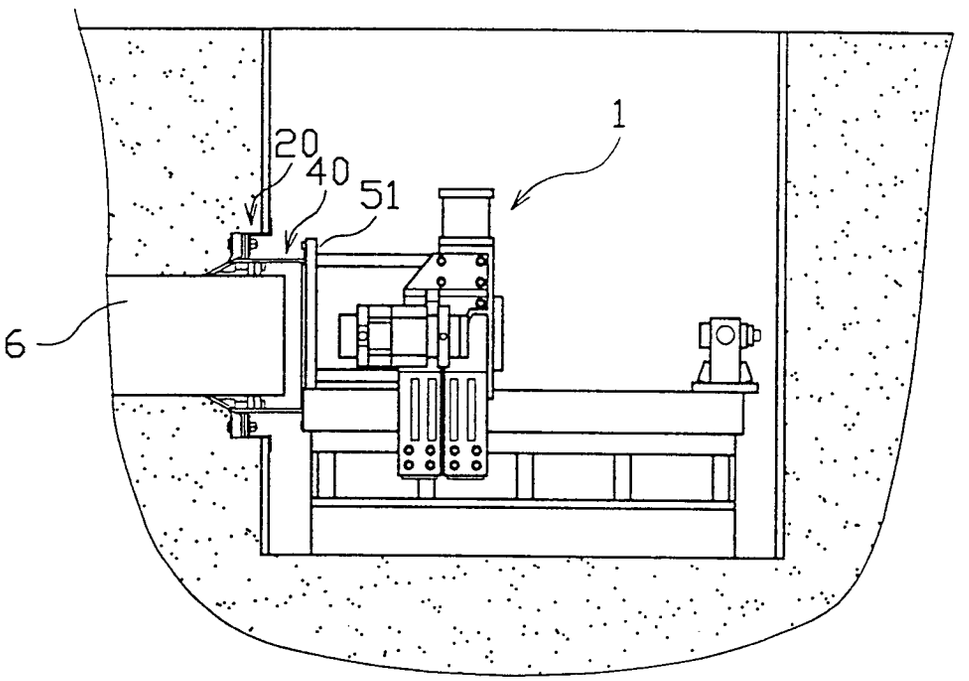


FIG.13

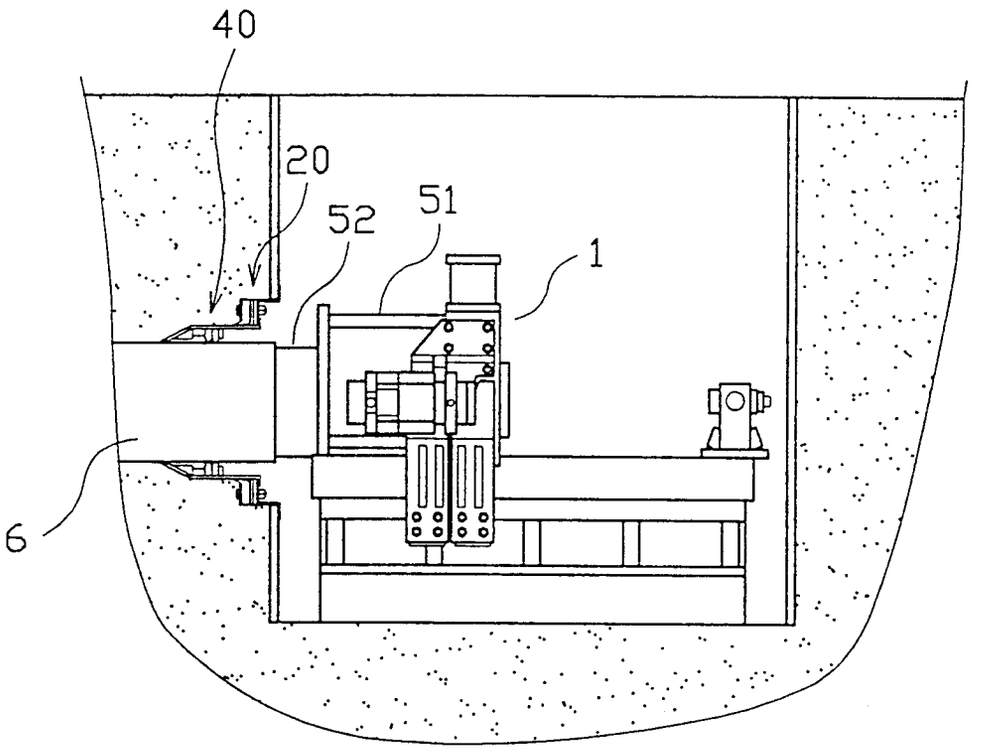
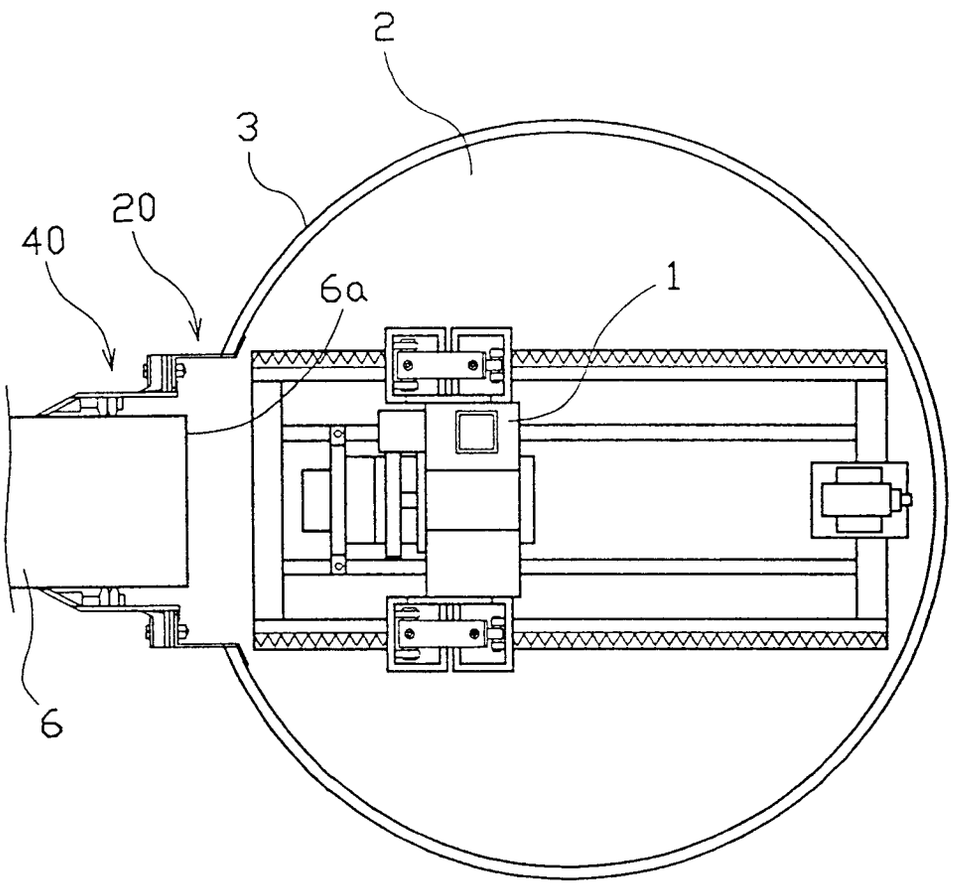


FIG. 14



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 11 3016

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.6)
A	US-A-3 958 648 (BPA BYGGPRODUKTION AB) * the whole document *	1-12	E21B7/20
A	EP-A-0 305 834 (MTS MINITUNNELSYSTEME GMBH) * figure 1 *	1,9	
A	EP-A-0 451 683 (KIDOH TECHNICAL INS) * column 10; figure 1 *	1,9	
A	US-A-3 912 024 (A.B. RICHMOND) * figures *	1,9	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E21B
E21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 April 1996	Fonseca Fernandez, H

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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