



(12)

EUROPEAN PATENT APPLICATION

(21) Application number : **92203591.0**

(51) Int. Cl.⁵ : **E02F 5/10**

(22) Date of filing : **20.11.92**

(30) Priority : **20.11.91 NL 9101937**

(43) Date of publication of application :
26.05.93 Bulletin 93/21

(84) Designated Contracting States :
BE DE FR GB IT NL

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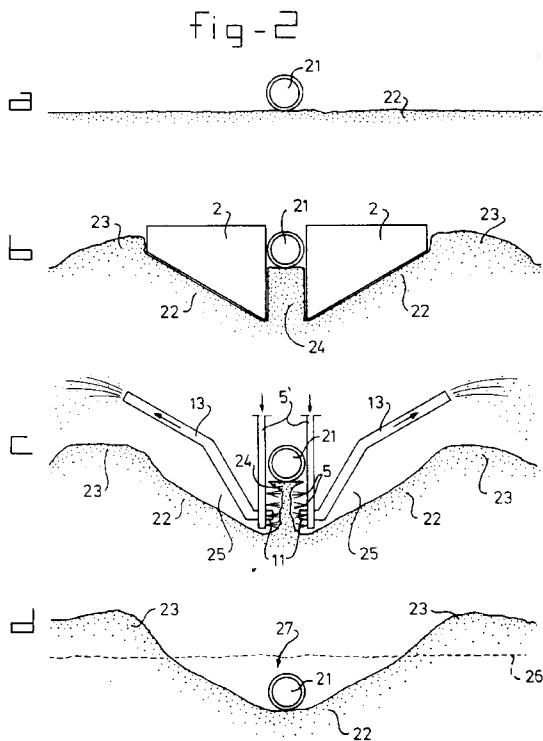
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(54) **Method for burying an elongated object.**

(57) The invention relates to a method and a device for burying a pipeline (11) in a bed (22) under water, in which a pipeline is laid on the bed and a device resting on the bed over the pipe is moved along the pipeline, while during this movement the device removes the bed material on either side and under the pipe, so that a trench (22) into which the pipeline sinks is formed, in which method the bed material on either side of the pipe is first removed, so that furrows running essentially parallel to the pipe are formed, and the bed material remaining between said furrows and on which the pipe is lying is then removed. The furrows are preferably formed by pushing away the bed material in the same way as with a plough, and the abovementioned bed material (24) remaining between the furrows is removed by sucking it away, so that a furrow into which the pipeline sinks remains. The bed material to be sucked away may first be loosened up by spraying with water to form a pumpable mixture.

A device for use of the method preferably comprises ploughshares (2) for making the furrows and a dredging pump unit for sucking away the bed part remaining between the furrows. The burial of the pipeline can be considerably simplified by using a high-pressure pump and spray nozzles. Flexibly mounted slippers facilitate the movement of the device over the bed.



The invention relates to a method according to the preamble of Claim 1 and a device according to the preamble of Claim 5.

A method and device for burying a pipeline in the ground are known from Dutch Patent Application 7808064. From the point of view of cost it is preferred first to lay the pipeline on the seabed using a relatively expensive device, and to bury it at a later stage using a cheaper device. The burial is important, on the one hand, in order to limit damage and corrosion through external influences and, on the other, in order to prevent the pipeline from lying unsupported above the bed over a great distance, on account of the undulating nature of the bed. In Dutch Patent Application 7808064 two cutting wheels fitted at an angle are placed at the side of the pipe. Using these, two furrows are cut out, in which case the body bearing the pipeline is a triangular shape. Such a body has little stability and when the cutting wheels are passing there is a risk of the pipe moving from the body, or the body collapsing. Another disadvantage is that during the passing through of relatively incohesive soil, the pipeline sinks when problems occur and comes to rest on the cutting wheels. Extremely complex constructions are necessary for folding out the cutting wheels, and there is still always the risk of damage to the cutting wheels and/or pipeline. When faults occur in the device it is difficult to remove the wheels, which grip under the pipe. With such a device it is not possible to produce a trench in various stages. This may be important in particular in the case of soil which has little cohesion. In the case of the device according to Dutch patent Application 7808064 there is then the risk that the body of material will collapse. If a cut of sufficient depth can be made in one go, the collapse of the body of material under the pipeline does not constitute a problem, but it has been found that this material spreads in such a way that the pipe does not come to rest at the deepest point of the furrow, but on an elevation formed by the material which originally formed the body of bed material.

The object of the present invention is to avoid these disadvantages.

This object is achieved by a method and device of the type described above by the characterising measures of Claim 1 and Claim 5, respectively.

The invention is based on the idea of making the furrows by ploughing. Ploughing is considerably simpler, requires a less complex device than rotary cutting, and uses less energy. Moreover, no special measures need be taken for the removal of material. For, the ploughshares shift the material in such a way that it is deposited in a desired position next to the furrows. It is important that the material should remain in the vicinity of the furrows, so that sufficient material is present to cover the pipeline which has been laid, if necessary. Making the body of material straight instead of triangular, as in the prior art, for one thing

means that it is not necessary to fit a complex fold-away mechanism for the ploughshares, for the ploughshares never go under the pipeline, so that they can always be removed. It is possible to plough a furrow in various stages to increasing depths, with the result that the tractive force can be limited. The triangular shape obtained with the ploughshares prevents the furrow just formed from immediately becoming silted up in the case of bed material which is relatively simple to shift. The use of ploughs also has the advantage that if there are stones in, for example, a sandy material, no damage occurs. These stones can be removed by passing through repeatedly. In the case of a cutter, damage and breakdowns occur when there are stones.

It is pointed out that a device is known from European Application 0,004,378 for laying pipelines underground. In this case furrows are made semi-continuously by sucking material from the ground. Such an operation requires an extremely large amount of energy (air). Vibrating and scraping devices are present in order to loosen the soil, so that it is easier to suck up. Apart from the increased energy consumption, there is also the problem of the removal of bed material. The use of air means that the working depth is restricted. It is not possible to carry this out efficiently according to the present invention. According to the invention, the body of bed material is removed by dredging.

Sucking away the remaining bed material can be considerably facilitated by first loosening up this bed material by spraying it with water to form a pumpable mixture, which is then sucked away.

A device operating by this method preferably comprises ploughshares mounted on a frame, which are placed on either side of the pipeline and according to the invention are fitted so that they are essentially immovable relative to the frame, and which serve only to make the abovementioned furrows, while means are placed behind the ploughshares for the removal of bed material lying between the furrows, which means comprise at least one dredging pump with one or more suction nozzles.

The removal of the bed material which has remained between the furrows can be facilitated considerably by fixing at least one spray nozzle directed at this bed material behind each ploughshare, so that this bed material is first loosened up by spraying with water to form a pumpable mixture, before it is sucked away.

For this purpose, the device is provided with a pump for water under pressure, which is connected to one or more spray nozzles. Considerable further advantages can be achieved by providing the device with extra spray nozzles. These can also be used when positioning relative to the pipe.

The tractive force required for the plough is reduced considerably by fixing at least one spray nozzle

at the toe of each ploughshare, so that water is sprayed and first slightly loosens the bed material, which is pushed away by the ploughshare

It is of great advantage also to fix at least one spray nozzle in the heel of each ploughshare, since when the device has stopped the breakaway forces of the ploughshares on the bed material can then be reduced.

In order to be able to take the plough back over a part of the pipeline which has not been properly buried, and to bury this part as yet, it is preferable to fix in front of the ploughshares slippers or similar elements, which are mounted on the frame in such a way that they can tilt sideways and forwards and are adjustable in height. This backward movement of the plough is made even easier by providing it with bevels on the rear side.

The present invention will be explained below in greater detail with reference to drawings, in which:

Figure 1 shows a device for use of a method according to the invention, in perspective; and

Figure 2 shows a diagrammatic representation of a method according to the invention.

The method according to the invention will first be explained in greater detail with reference to Figure 2, which shows diagrammatically and in cross-section a preferred method according to the invention.

Figure 2a shows a pipeline 21 which is placed on a bed under water.

Figure 2b shows two ploughshares 2, which are moved along on either side of the pipeline 21. Bed material 22 is pushed away to the sides by these ploughshares 2 during this forward movement, while mounds 23 of displaced bed material 22 and furrows 25 (Figure 2c) are formed on either side of the pipeline. During this ploughing some bed material 24 remains between the ploughshares 2, under the pipeline 21. This bed material 24 provides temporary support for the pipeline 21.

Fig. 2c shows that, directly after furrows 25 are formed by the ploughshares 2 on either side of the pipeline 21, the bed material 24 lying between the furrows 25 and under the pipeline 21 is sucked away through suction nozzles 11 which are situated on either side of the pipeline 21 in the furrows 25, and which are connected by means of dredging pump units (not shown in Figure 2c) to discharge pipes 13. The extraction of bed material 24 is facilitated by first loosening up this bed material 24 by spraying water under pressure on the bed material 24 through pipes 5' and spray nozzles 5 to produce a pumpable mixture.

As shown in Figure 2d, after the bed material 24 has been sucked away a furrow 27 remains, in which furrow the pipeline 21 is sunk. If desired, the bed material 23 lying on either side of the furrow 27 can also be used for burying the pipeline, so that the bed becomes approximately flat again, as shown by means

of dashed line 26.

Figure 1 shows a preferred device for use of the method according to the invention. This device comprises a frame 1, to the front side of which slippers 7 are fixed by means of hinged fastenings 8, 9 and 10, behind that ploughshares 2, and further, inter alia, a high-pressure pump 4 for each ploughshare, which high-pressure pumps 4 lead to a manifold 4' which is connected to spray nozzles 5 and 6, and dredging pumps 3, which are connected to suction nozzles 11.

The ploughshares 2 are essentially fixed to the frame 1, although it is possible in principle to adjust them.

Two essentially parallel plates 30 are also essentially fixed to the frame. Fastened on the plates 30 are the suction nozzles which extract the bed material through holes made in said plates.

The purpose of the spray nozzles 5 (which can be seen only in the case of one ploughshare), which are also fixed on the plates 30 and directed at the remaining bed material, is to loosen up to the form of a pumpable mixture the bed material 24 (Figure 2) which is to be sucked away by means of the suction nozzles 11, dredging pumps 3 and discharge pipes 13, before it is sucked away. The plates 30 here ensure, inter alia, that the effect of the water sprayed through spray nozzles 5 onto the remaining bed material 24 is limited to this bed material 24.

Spray nozzles can be fixed at the suction nozzles 30, 11, in order to be able to clear blockages of said suction nozzles.

The forces required for moving the device along in the direction of arrow P can be reduced considerably by using a few extra spray nozzles. The two spray nozzles 6 (one of which cannot be seen) in the toes of the ploughshares reduce the tractive forces required for normal forward movement, by loosening up the bed material here to some extent. The tractive forces can be further reduced by correspondingly providing more spray nozzles at the ploughshares. In order to reduce, for example, the so-called breakaway forces after the device has stopped, it is recommended that one or more spray nozzles, not shown here, should be fixed near the heel parts 12 of the ploughshares 2.

The slippers 7 fixed at the front are tiltable in the direction of movement, arrow P, by means of the hinged connections 8. The hinged fastenings 9 mean that the slippers 7 are also tiltable in the direction perpendicular to the direction of movement. The slippers 7 can be adjusted in height by means of the hinged fastenings 10.

The above-described hinged fastenings 8, 9 and 10 of the slippers 7 ensure that the device can be moved easily over an uneven surface. These hinged fastenings also mean that the device can easily be moved again through a furrow 27 already formed (Figure 2d), for example if this furrow 27 is too shallow.

low.

The backward movement of the device in the direction of arrow T is facilitated by bevelling the rear sides of the plates 30 relative to the bed, and fixing a plate 32, also slanting relative to the bed, on each of these bevels 31, which plate extends essentially crosswise to the plate 30 concerned in the direction of the corresponding ploughshare 2.

Claims

1. Method for at least partially burying an elongated object, such as a pipeline, in the ground, comprising the laying of said object on the ground, forming parallel furrows in the ground on either side of the object, while not acting on the body of bed material supporting the object, and then removing the body of bed material, characterised in that the formation of the trenches in the ground involves ploughing with a ploughing device provided with ploughshares, in which the ploughshares are set in such a way that they leave clear the body of bed material forming the vertical projection of the object.

2. Method according to Claim 1, in which the furrows are made essentially triangular.

3. Method according to Claim 1, in which the body of bed material is removed by dredging.

4. Method according to Claim 3, in which the bed material is loosened up by spraying before or during the dredging.

5. Device for at least partially burying an elongated object, such as a pipeline, in the ground, comprising means for making furrows on either side of said pipeline, and means for removing the body of material under said pipeline between said furrows, characterised in that the means for making furrows comprise ploughing means with ploughshares (2), the ploughshares (2) being made vertical at the front side, viewed in the direction of movement in the use position.

6. Device according to Claim 5, comprising a frame (1) having ploughshares (2) which are mounted on said frame and can be placed on either side of the pipeline, and which are fitted so that they are essentially immovable relative to the frame, and in which the means for the removal of the body of bed material (24) between the furrows (25) are placed behind the ploughshares (2) and comprise at least one dredging pump (3) with one or more suction nozzles (11).

7. Device according to Claim 6, comprising a pump (4) for water under pressure, in which this pump (4) is connected to the spray nozzles (5, 6).

5 8. Device according to Claim 7, in which at least one spray nozzle (5) directed at the remaining bed material (24) is fixed behind each ploughshare (2).

10 9. Device according to one of Claims 7 or 8, in which at least one spray nozzle is fixed at each suction nozzle (11), for clearing and/or preventing blockages in said suction nozzle (11), at least one spray nozzle being fixed at the toe of each ploughshare (2) and at least one spray nozzle being fixed at the heel (12) of each ploughshare (2).

15 10. Device according to one of Claims 6 - 9, in which slipper elements (7) for the ploughshares are fitted on the frame in such a way that they are tiltable sideways and/or forwards and/or are adjustable in height.

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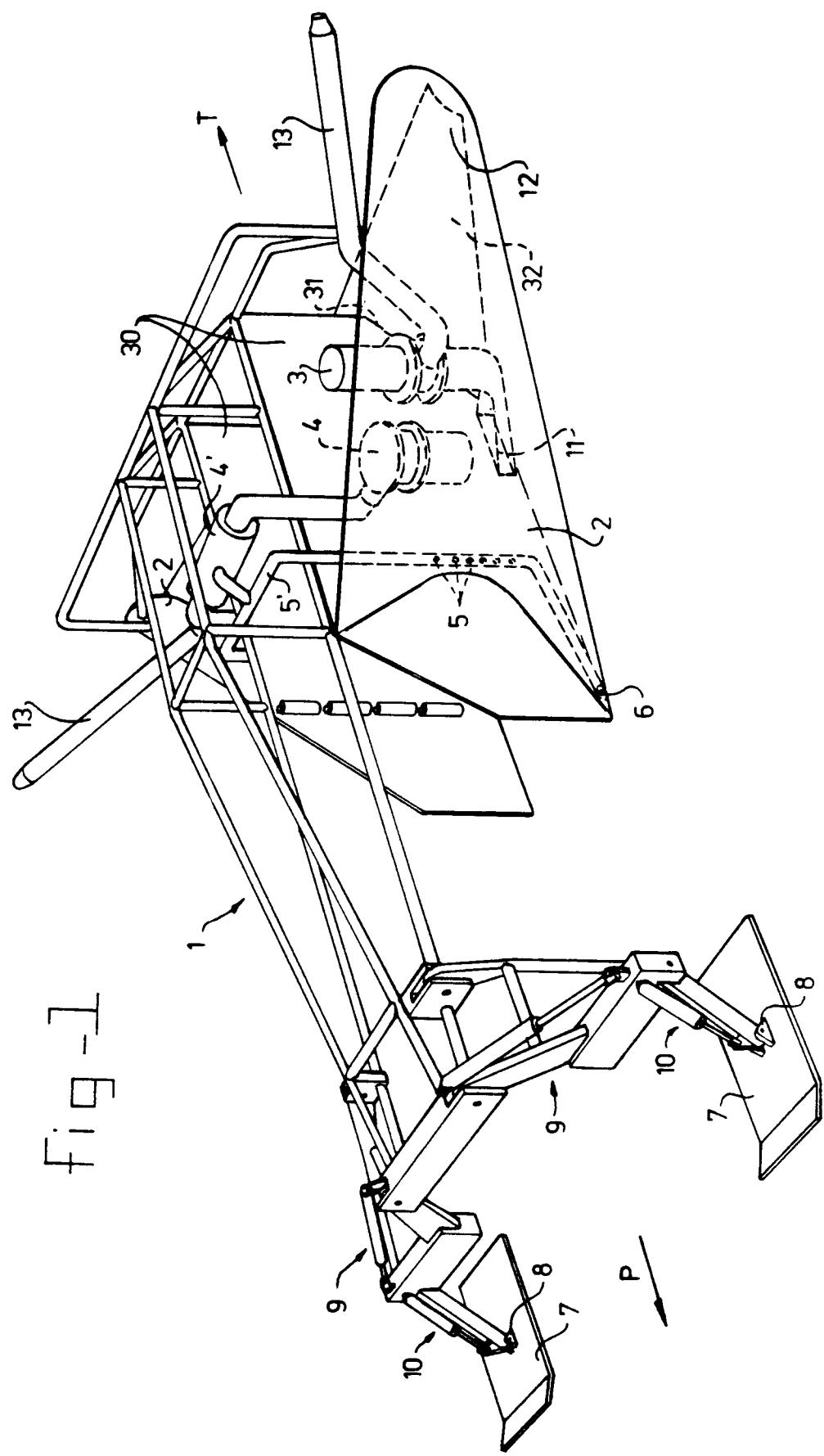
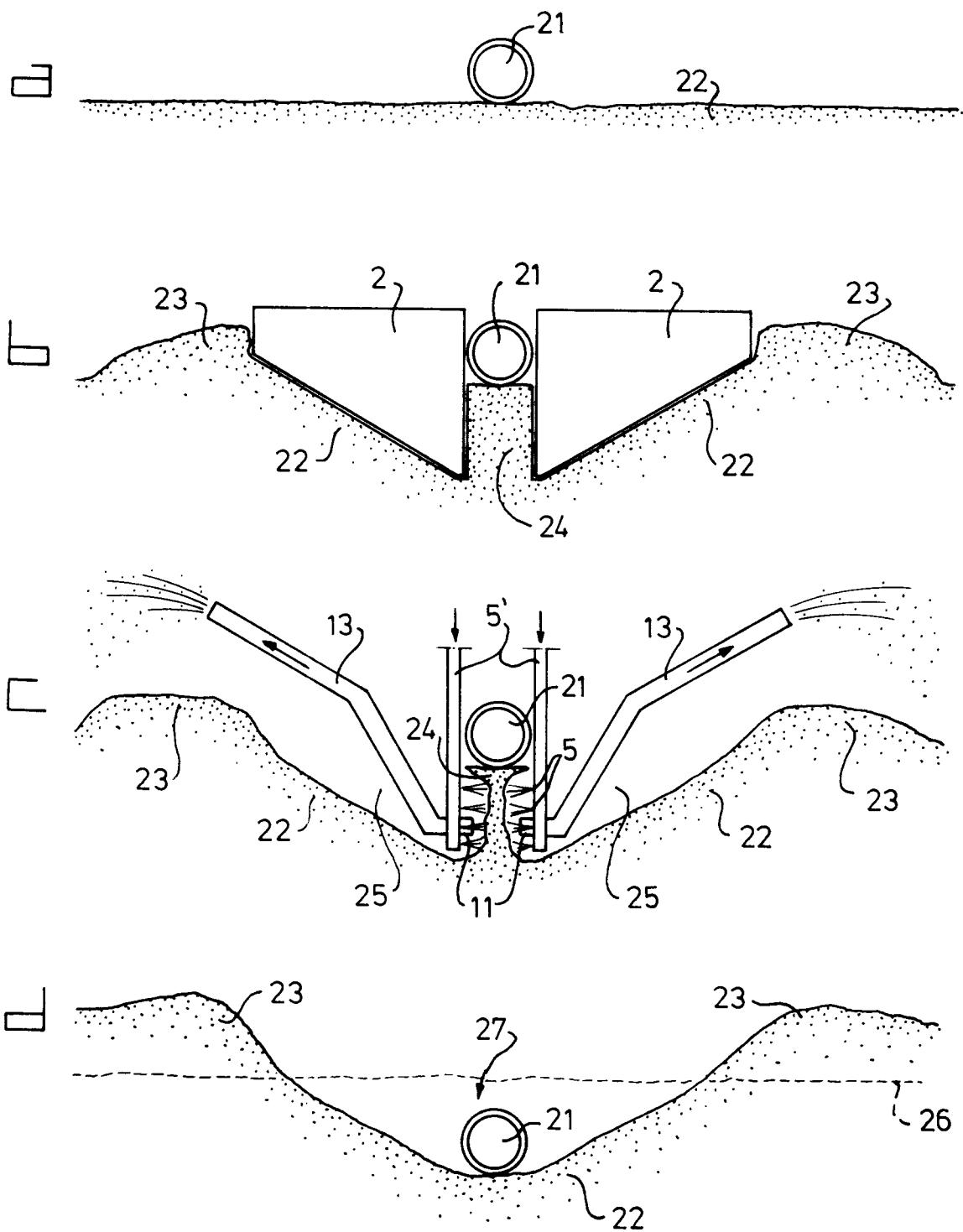


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European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 92 20 3591

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
Y	US-A-4 301 606 (HOFMEESTER) * column 6, line 59 - column 7, line 23; figures 5-7 *	1-6,10	E02F5/10
D	& NL-A-7 808 064 (NETHERLANDS OFFSHORE CY) ---		
Y	FR-A-2 425 601 (GIBSON INDUSTRIES) * figures *	1-6,10	
D,A	EP-A-0 004 378 (EPI PNEUMA SYSTEM) * page 13, line 10 - line 22 * * page 19, line 7 - line 20; figures *	1-11	
A	GB-A-1 348 487 (NETHERLANDS OFFSHORE COMPANY) ---		
A	GB-A-2 058 883 (SANTA FE INTERNATIONAL CORP.) ---		
A	GB-A-2 006 302 (MOBELL LTD) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			E02F
<p>The present search report has been drawn up for all claims</p>			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	08 MARCH 1993	DE SCHEPPER H.P.H.	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			